POLICY ISSUE
(Information)

April 22, 2005 SECY-05-0069

FOR: The Commissioners

FROM: Luis A. Reyes
Executive Director for Operations /RA/

SUBJECT: FY 2004 RESULTS OF THE INDUSTRY TRENDS PROGRAM FOR OPERATING POWER REACTORS AND STATUS OF THE ONGOING DEVELOPMENT OF THE PROGRAM

PURPOSE:

To inform the Commission of the results of the Nuclear Regulatory Commission's (NRC's) Industry Trends Program (ITP) for FY 2004 and the status of the ongoing development of the program.

SUMMARY:

This report documents the results of the analysis of the FY 2004 industry-level performance indicators and summarizes the status of the ongoing development of the ITP. Based on the information currently available from the industry-level indicators and the Accident Sequence Precursor (ASP) Program, no statistically significant adverse industry trends have been identified through FY 2004. In addition, no issues that warranted further analysis or significant adjustments to the nuclear reactor safety inspection or licensing programs were identified by short-term trending of the FY 2004 data.

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BACKGROUND:

The NRC staff implemented the ITP in 2001. The NRC uses industry-level indicators to identify adverse trends. Adverse trends are assessed for safety significance and the NRC responds as necessary to any identified safety issues, including adjustments to the inspection and licensing programs if necessary. One important output of this program is the annual agency performance measures reported to Congress on the number of "statistically significant adverse industry trends in safety performance." This outcome measure is part of the NRC's Performance and Accountability Report. In addition, the results of the ITP, along with any actions taken or planned, are reviewed annually during the Agency Action Review Meeting (AARM) and reported to the Commission. This paper is the fifth annual report to the Commission on the ITP.

The Reactor Oversight Process (ROP) uses plant-level performance indicators (PIs) and inspections to provide plant-specific oversight of safety performance, and the ITP uses industry-level indicators to assess the overall outcome of the industry's and the NRC's regulatory performance. Issues identified by the ROP and the ITP are evaluated using information from agency databases. Issues that have generic safety significance are addressed using existing NRC processes and programs, including generic safety inspections in the ROP, the generic communications process, and the generic safety issue process.

The ITP is a joint effort between the Inspection Program Branch in the Office of Nuclear Reactor Regulation (NRR) and the Operating Experience and Risk Analysis Branch in the Office of Nuclear Regulatory Research (RES). The objectives of the ITP are to assess whether the nuclear industry is maintaining the safety performance of operating reactors, to clearly communicate the results, and to contribute to the openness in the NRC's regulatory process. The specific objectives of the ITP are as follows:

(1) Collect and monitor industry-wide data that can be used to assess whether the nuclear industry is ensuring the safety performance of operating plants and to provide feedback on the nuclear reactor safety inspection and licensing programs.

(2) Assess the safety significance and causes of any statistically significant adverse industry trends, determine if the trends represent an actual degradation in overall industry safety performance, and respond appropriately to any safety issues.

(3) Communicate performance information to Congress and other stakeholders in an effective and timely manner.

(4) Support the NRC's strategic goals.

The NRC currently uses the results of the ITP in the following ways:

(1) The NRC reports the number of statistically significant adverse industry trends in safety performance and summarizes key ITP results to Congress annually in the NRC's "Performance and Accountability Report, Fiscal Year 200X" (NUREG-1542 series) and in the NRC's "Budget Estimates and Performance Plan, Fiscal Year 200X"

(NUREG-1100 series). The ITP performance measure demonstrates how successfully the agency's programs are maintaining industry safety performance.

(2) The NRC communicates detailed industry performance to stakeholders by publishing the ITP indicators on the agency's public Web site at *http://www.nrc.gov/reactors/operating/oversight/industry-trends.html*. The staff believes that communicating the industry-level indicators, in addition to plant-specific information from the ROP, enhances stakeholder confidence in the effectiveness of the NRC's oversight of the nuclear industry.

(3) The results of the ITP are a key element of senior NRC management review of the agency's oversight programs for operating facilities during the annual AARM.

(4) The staff informs the Commission of the results of the ITP in an annual report before the AARM.

(5) The Commission uses the ITP indicators when presenting the status of industry performance to the NRC's congressional oversight committees and at major conferences with stakeholders.

(6) NRC managers use the ITP indicators to provide an overview of industry performance at NRC's Regulatory Information Conference and other conferences with stakeholders.

DISCUSSION:

The ITP is intended to monitor trends in industry safety performance so that the staff can identify and address adverse industry trends. The ITP indicators track known conditions and issues. The indicators are comprehensive and based on the best available data. However, the staff recognizes that there are limits to what can be tracked and trended by the ITP. Oversight of plant-specific conditions and events is provided by the ROP.

RESULTS OF FY 2004 TREND ANALYSES

The ITP and the ASP Program provide the basis for agency monitoring and reporting to Congress on the number of statistically significant adverse industry trends in safety performance, a performance goal measure established by the NRC's strategic plan. In deciding to revise the oversight process for operating power reactors, the agency cited the ITP indicators as evidence of improvements in industry safety performance. A summary of the ITP process is outlined in Attachment 4.

Based on the ITP indicators and the ASP Program results, the staff identified no statistically significant adverse trends in industry safety performance through the end of FY 2004. The long-term trends of the indicators are shown in the graphs in Attachment 1.

To identify potential short-term, year-to-year emergent issues before they become long-term trends, the staff used a statistical approach based on "prediction limits." No prediction limits were exceeded in FY 2004. Graphs with the prediction limits for each of the indicators are given in Attachment 2.

Although the ASP indicator did not result in a statistically significant adverse trend, the staff previously noted an increasing number of precursors between 2000 and 2002 when compared to the relatively low number of precursors between 1997 and 1999. The staff has initiated a detailed evaluation of the ASP data to investigate the nature of the trends to determine whether there is an explanation for the relatively low number of precursors between 1997 and 1999 and the increasing number of potential precursors in 2000—2002. This is part of an effort to identify any engineering insights from ASP data that can be applied in the NRC's regulatory programs.

ITP DEVELOPMENT

1. Development of an ITP Inspection Manual Chapter

The staff is developing an Inspection Manual chapter to document the details of the ITP and is planning to issue the document before the end of FY 2005. The Inspection Manual chapter will include definitions, data sources, calculations, and statistical methods for each indicator.

The Inspection Manual chapter will also identify which indicators have been qualified for use in reporting against the measure of the number of statistically significant adverse trends. The Inspection Manual chapter will be updated as additional indicators are qualified for use in reporting against this measure.

2. Development of Additional, More Risk-Informed Indicators

The staff has continued to develop additional indicators that are more risk-informed and better aligned with the cornerstones of safety in the ROP. For example, the staff has continued development of industry-level indicators from the data submitted by licensees for the plant-level ROP PIs. Graphs of these indicators are given in Attachment 3. Based on the indicator data through FY 2004, there were no statistically significant adverse trends. The staff is evaluating these indicators for inclusion in the ITP. The plan is to include the following ROP indicators: unplanned power changes, reactor coolant system activity, reactor coolant system leakage, drill/exercise performance, emergency response organization (ERO) drill participation, and alert and notification system reliability. Other ROP indicators — unplanned scrams, scrams with loss of normal heat removal, safety system unavailability (SSU), safety system functional failures, and occupational exposure control effectiveness — will not be used because they duplicate information provided by the current industry trend indicators. In addition, the SSU indicators will not be used because the staff is currently working on a replacement for these indicators. The staff will identify the ITP indicators to be used in the Inspection Manual chapter being developed for the ITP (as discussed above).

In SECY-04-0052, the staff reported on the continued development of an index for boiling water reactors that monitors 9 risk-significant initiating events and a similar index for pressurized water reactors that monitors 10 events (the additional event category is steam generator tube rupture). Each initiating event is weighted in the index according to its relative contribution to industry core damage frequency. This indicator is called the baseline risk index for initiating events (BRIIE). The staff has continued the developmental work during FY 2004. The staff still has to respond to comments received, update risk importance measures (to reflect updated Standardized Plant Analysis Risk [SPAR] models), and develop thresholds for agency response. The staff's goal is to carry out a pilot program and possibly implement BRIIE within 1–2 years. Implementation details for BRIIE will also be included in the Inspection Manual chapter being developed for the ITP.

3. Modifications to the Long-Term Trending Methodology

The ITP has used the "fitted" trend lines (shown in Attachment 1) to determine if there were statistically significant adverse trends. Long-term fitted trend lines from 1988 have worked well for describing the observed data. The prediction limits (for short-term trending) are based on more recent performance. With current industry performance apparently leveling off relative to performance in the 1988 timeframe, the staff wants to ensure that a possible recent trend is not masked by using the older data. The staff and its contractor are evaluating the time span to use for long-term fitted trend lines. The object of the evaluation is to determine a time span long enough to detect a valid trend but short enough to ensure that older data does not overly influence the more recent data. The current plan is to determine the fitted trend lines using 10 years of data (the 10-year rolling trend). The ITP Inspection Manual chapter will include the details of the long-term trending methodology and the technical basis for the methodology.

COMMITMENTS:

Listed below is the activity committed to by the staff in this paper:

> The staff will develop an Inspection Manual chapter in FY 2005 to document the details of the ITP.

RESOURCES:

For FY 2005, NRR has budgeted resources of approximately 0.7 full-time equivalent (FTE) and $295K for the continued development and implementation of the ITP. For FYs 2006 through 2008, NRR estimates resource requirements of approximately 0.7 FTE per year, and $295K per year for contractor funding. NRR has included these requirements in its budget request submittals. Research support to the Industry Trends Program involves operating experience data and models developed and budgeted under other RES programs, such as ASP. Research also directly supports the ITP through the development of BRIIE. For FY 2005, RES has budgeted resources of approximately 0.1 FTE and $50K for the continued development of BRIIE. For FY 2006, RES has budgeted resources of approximately 0.5 FTE and $150K. The resources budgeted in NRR and RES are adequate for ongoing ITP implementation.

COORDINATION:

The Office of the Chief Financial Officer has reviewed this paper and concurs.

The Office of the General Counsel has reviewed this paper and has no legal objection.

/RA/ Original signed by William F. Kane for
Luis A. Reyes
Executive Director
for Operations

Attachments:
1. FY 2004 Long-Term Industry Trend Results
2. FY 2004 Short-Term Industry Trend Results
3. FY 2004 Industry-Level Rollup of ROP PIs
4. Summary of Industry Trends Program Process

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DATE	4/05/05	4/22/05			

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FY2004 Long-Term Industry Trend Results

Automatic Scrams While Critical

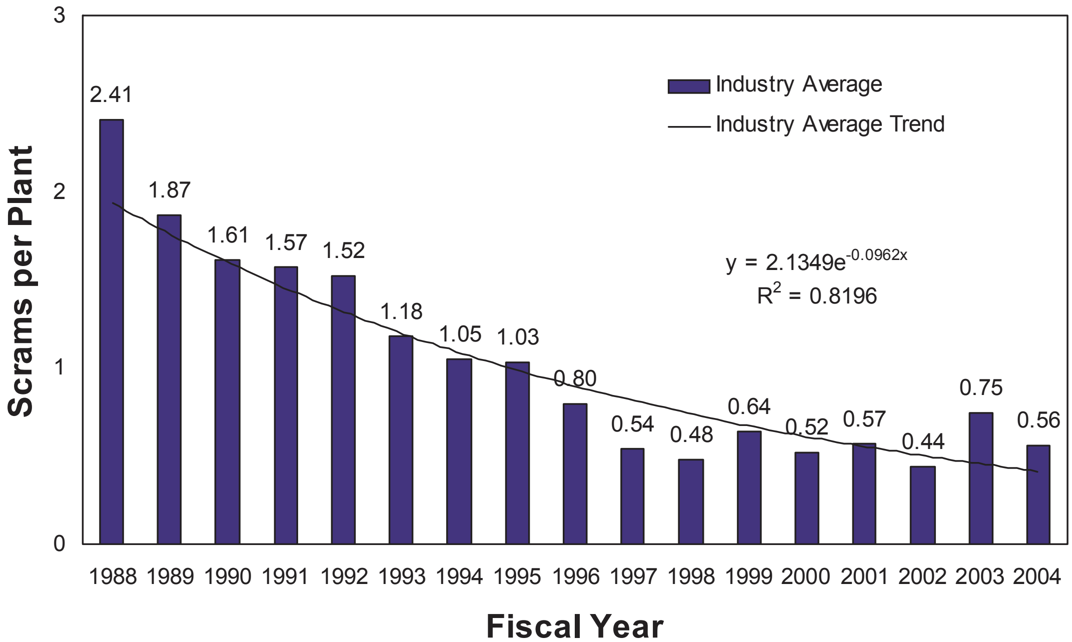

Figure A1-1

Safety System Actuations

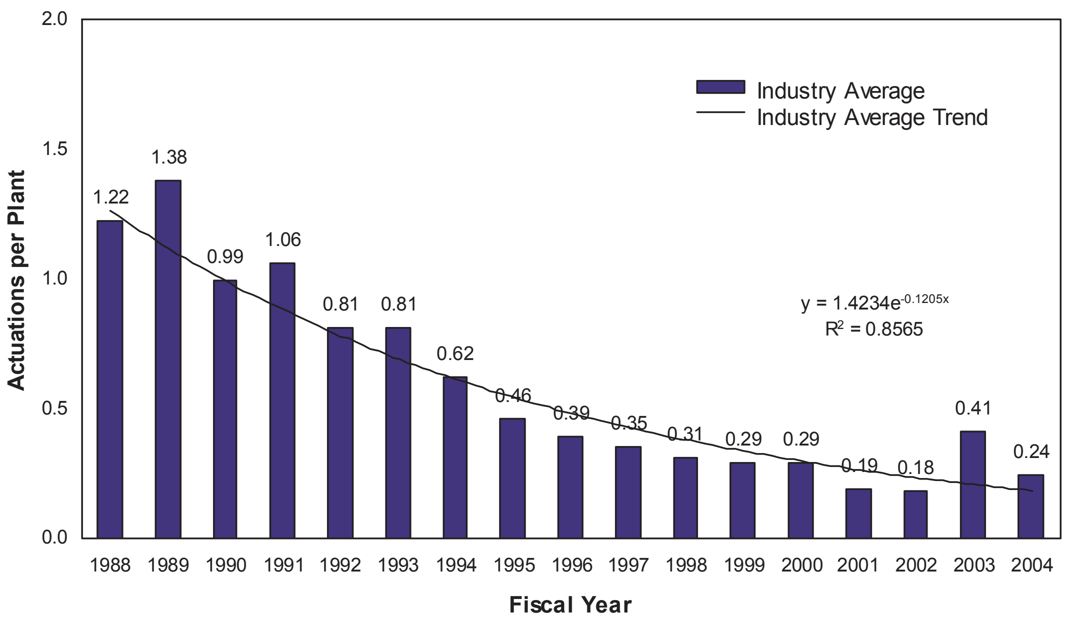

Figure A1-2

ATTACHMENT 1

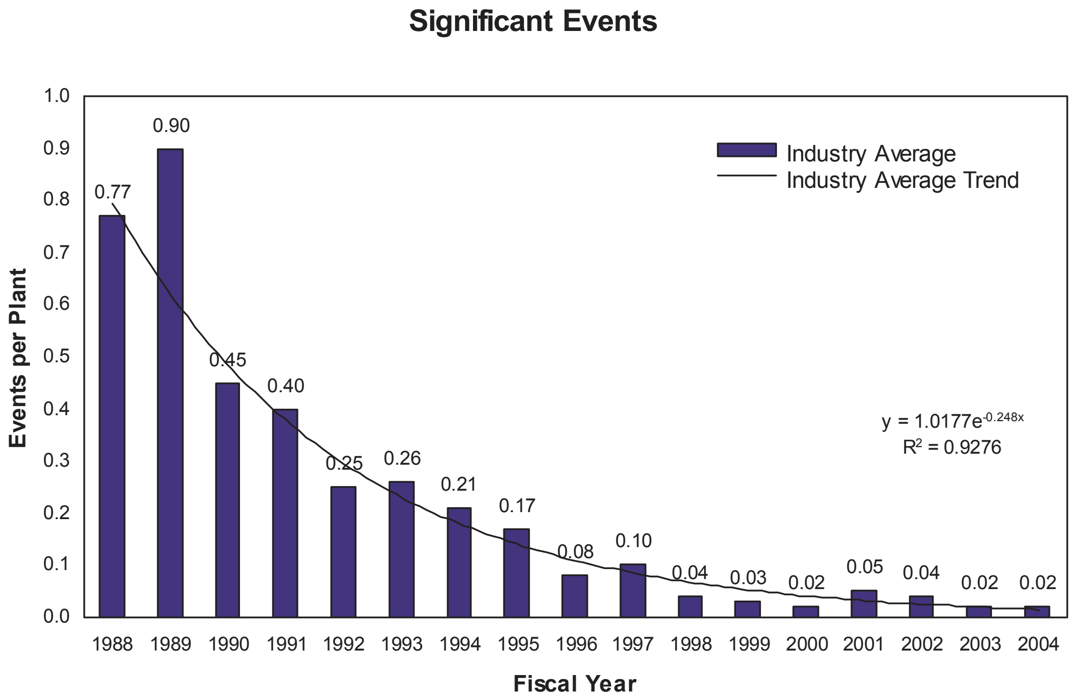

Figure A1-3

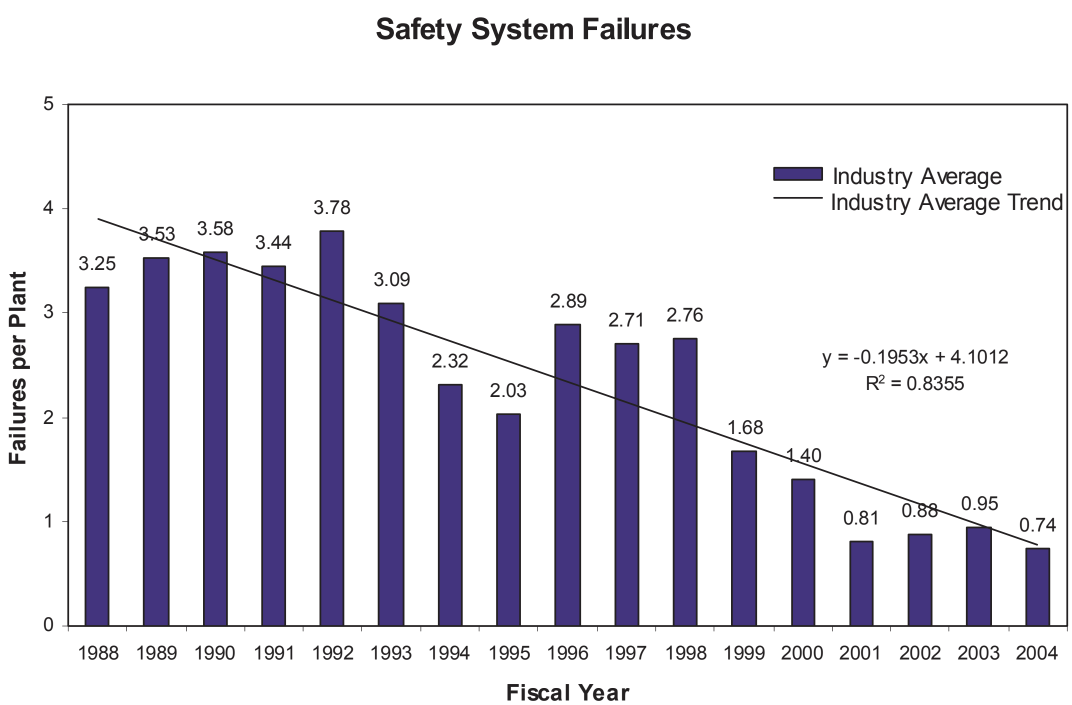

Figure A1-4

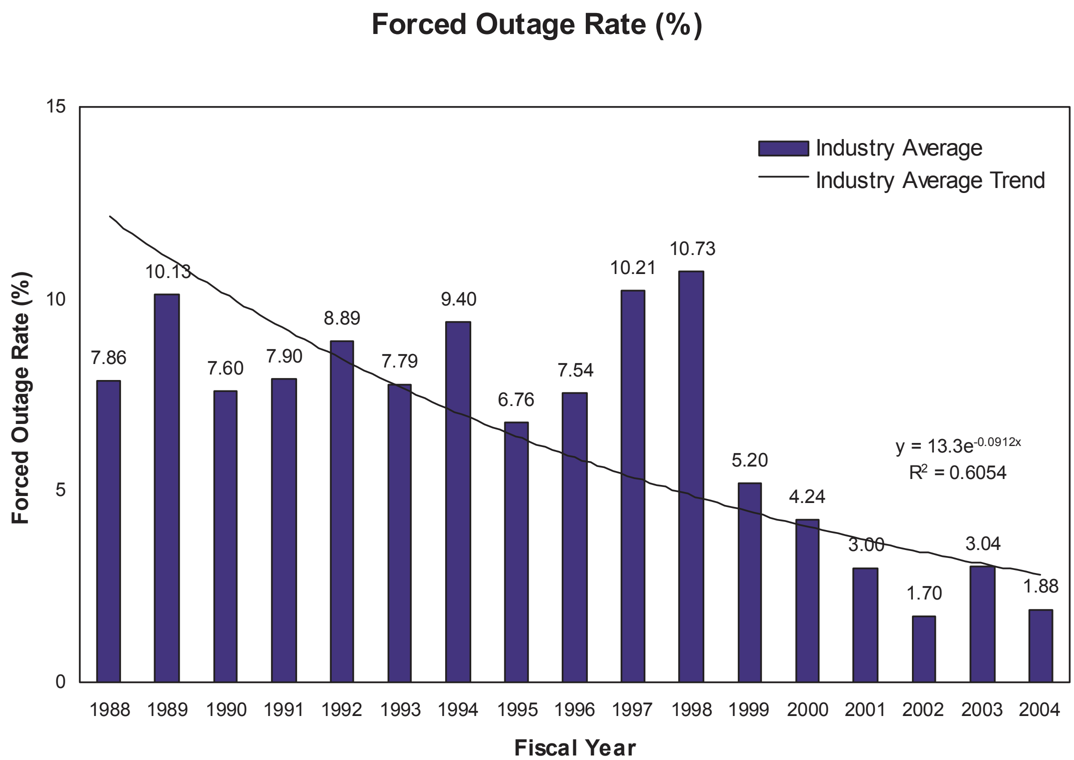

Figure A1-5

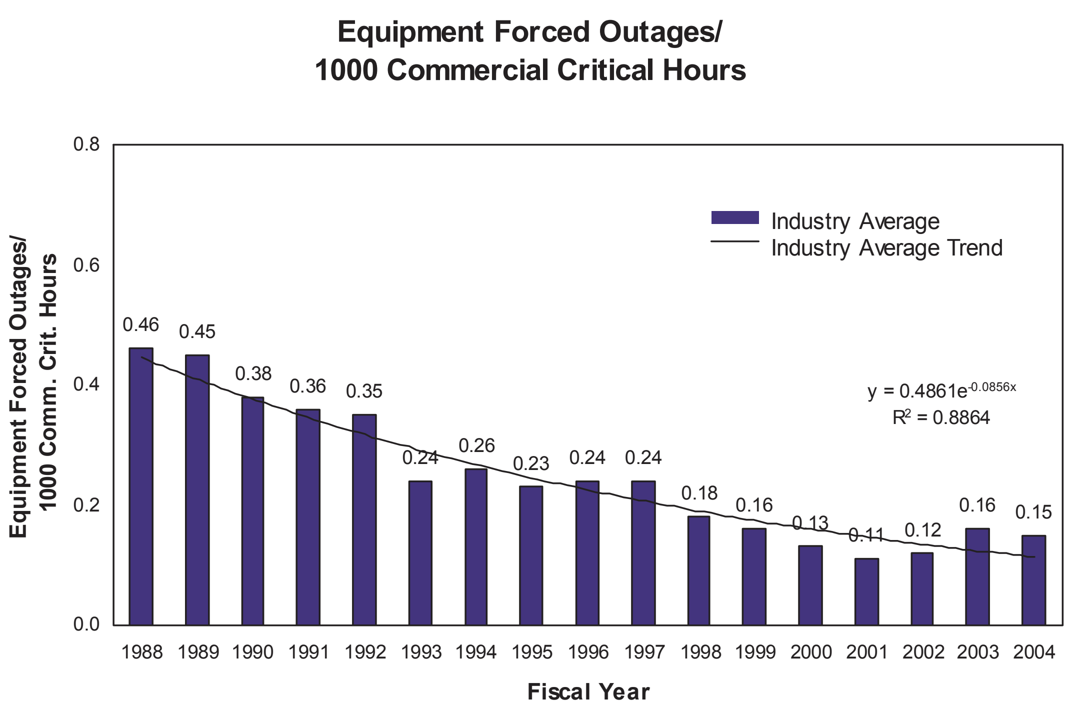

Figure A1-6

Collective Radiation Exposure

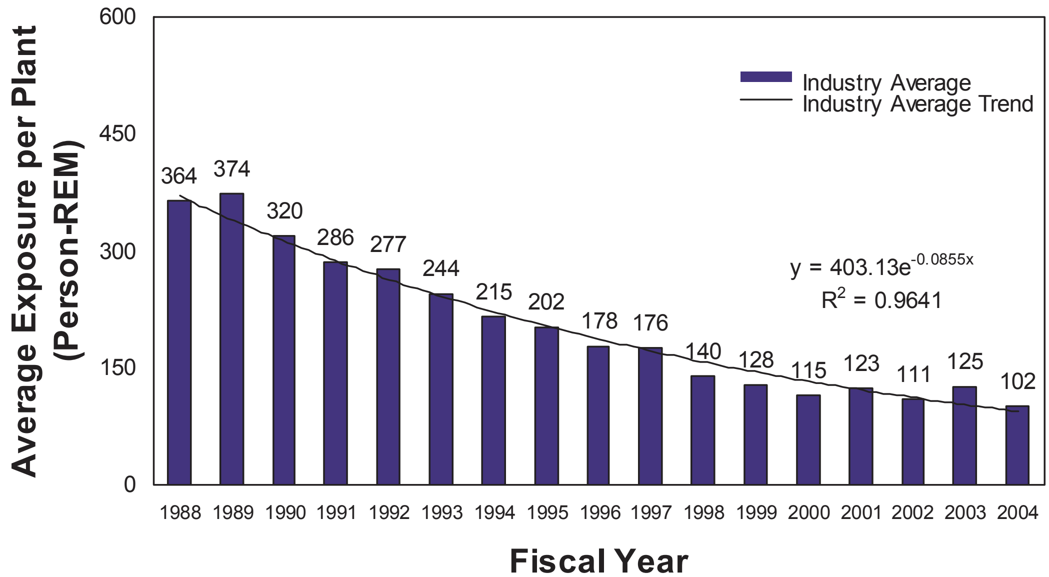

Figure A1-7

Accident Sequence Precursor Trends

The data used in the trending analyses span the period from FY 1993 through FY 2003. Although the staff is still conducting its preliminary analyses of cracking that occurred in control rod drive mechanism housings during FYs 2001 and 2002, sensitivity analyses conducted to date show that these cracking events are most likely potential precursors but not significant precursors. Therefore, the staff has included these events in the total count and trending of all precursors (i.e., CCDP and ΔCDP $ 1x10E-6).

No statistically significant trend has been observed in the occurrence rate for all precursors that occurred during the period from 1993 through 2003. Figure A1-8 below depicts the occurrence rate per reactor-year for all precursors by fiscal year.

The Office of Nuclear Regulatory Research is working to improve the efficiency and streamline the ASP program, with a goal of completing the analysis of potential precursors within 4—12 months following the initiation of an event or the discovery of the condition. The details of this plan are contained in SECY-04-0210, “Status of the Accident Sequence Precursor (ASP) Program and the Development of Standardized Plant Analysis Risk (SPAR) Models.”

Although Figure A1-8 shows the ASP results for events that occurred before FY 1993, these events are not taken into consideration for statistical trending since they were derived using a less-rigorous methodology. The ASP events that occurred before FY 1993 are only shown to provide historical perspective.

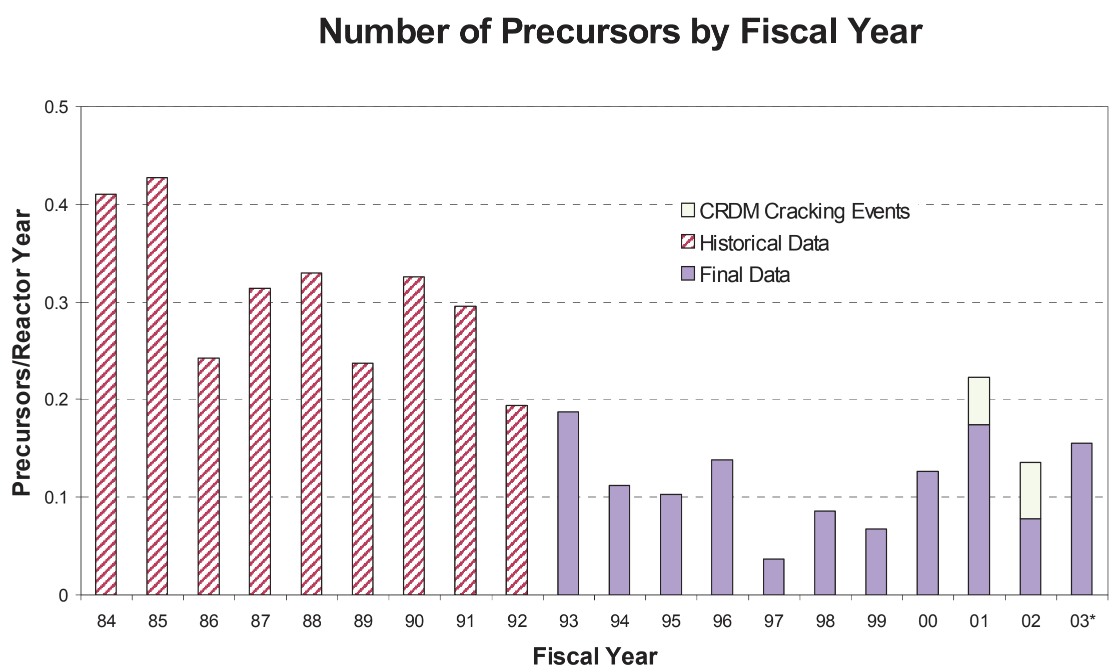

Figure A1-8

FY 2004 Short-Term Industry Trend Results

Automatic Scrams While Critical

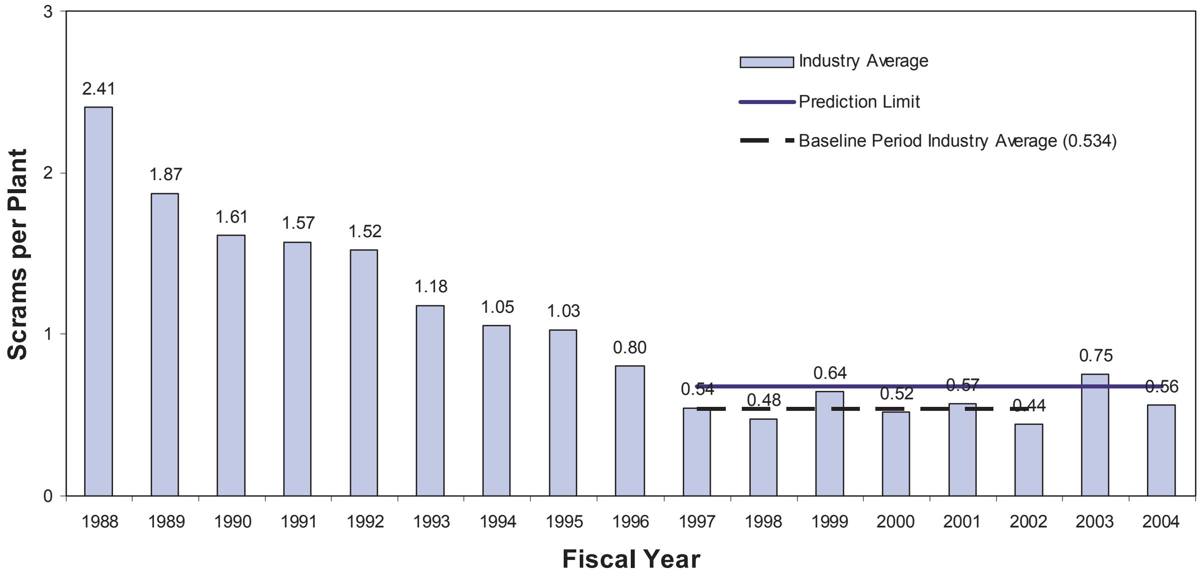

Figure A2-1

Safety System Actuations

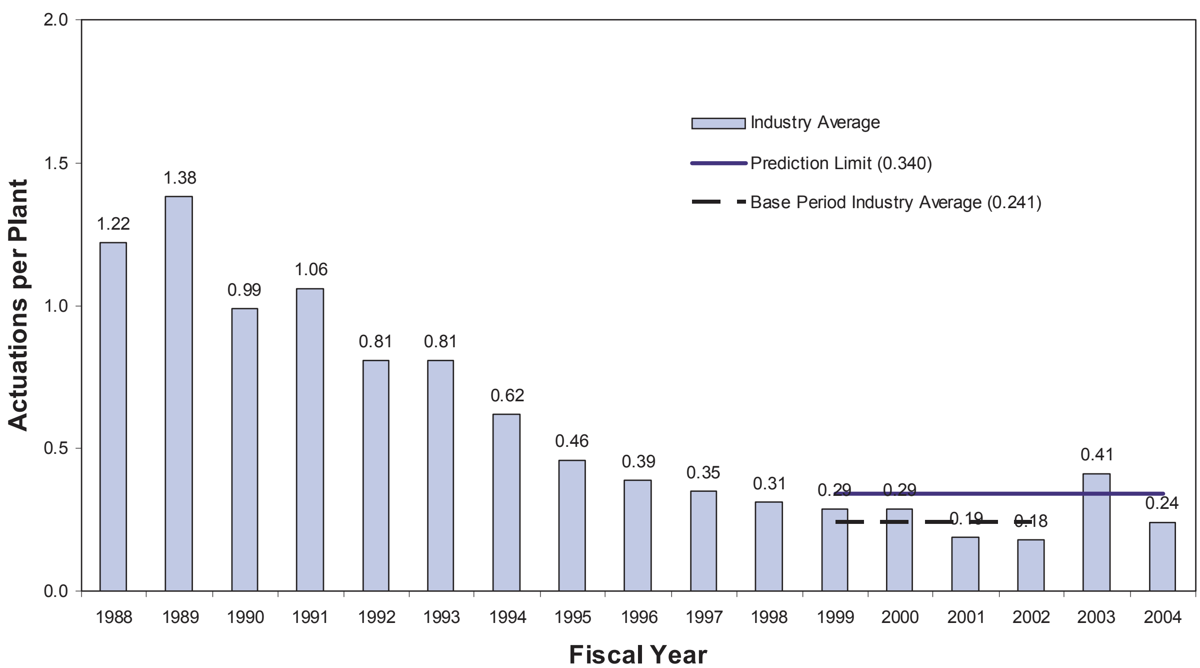

Figure A2-2

ATTACHMENT 2

Significant Events

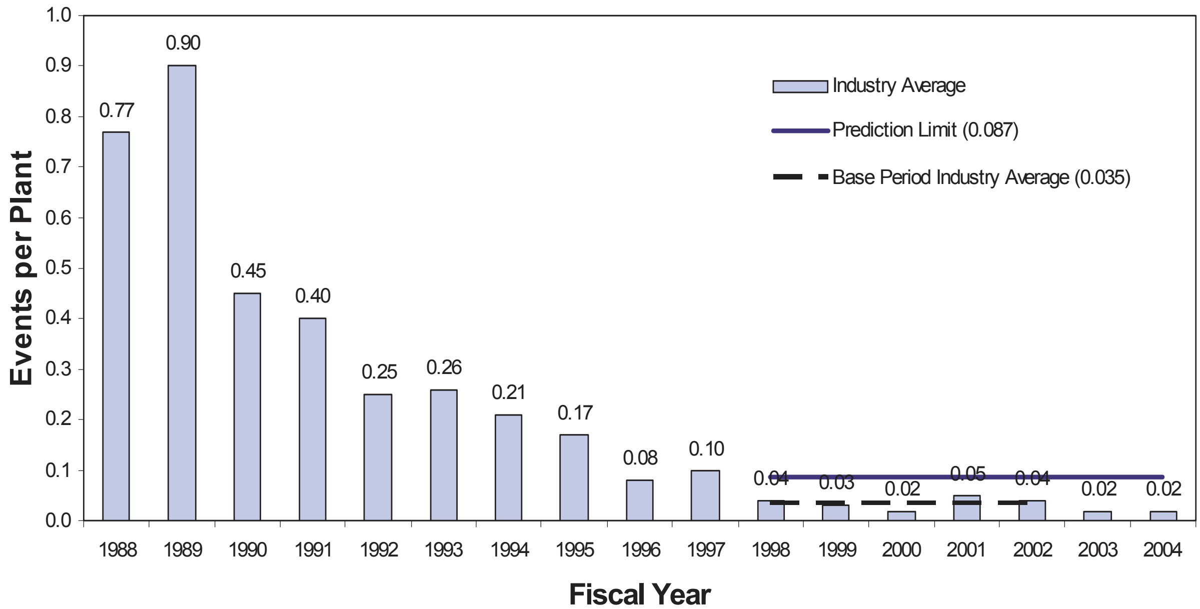

Figure A2-3

Safety System Failures

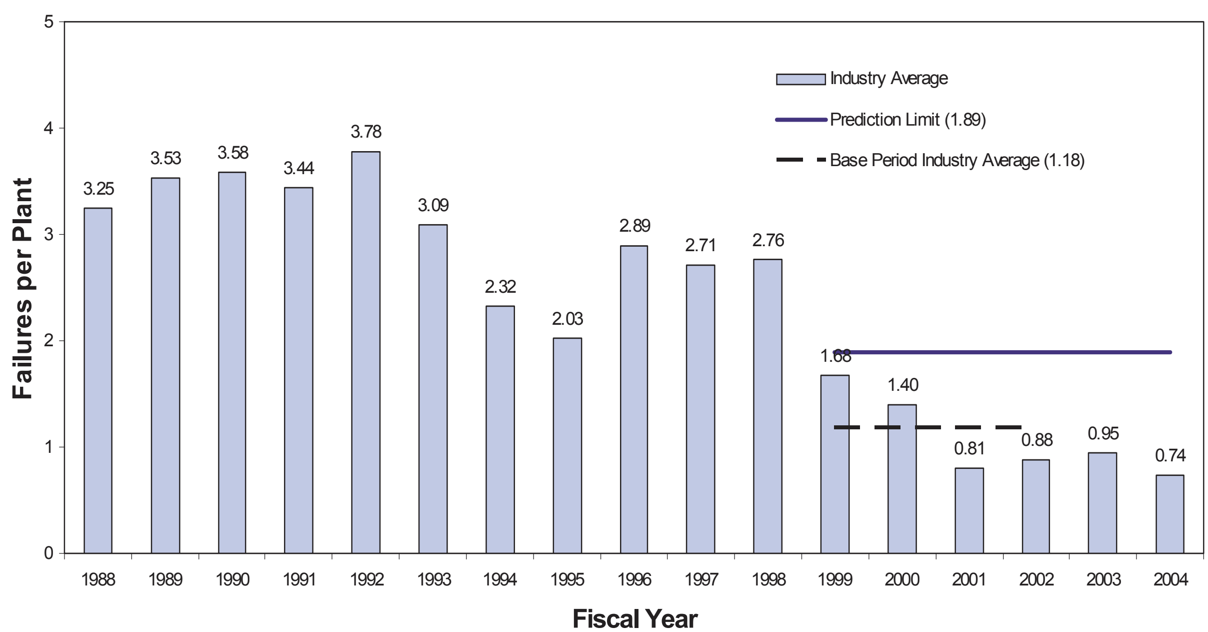

Figure A2-4

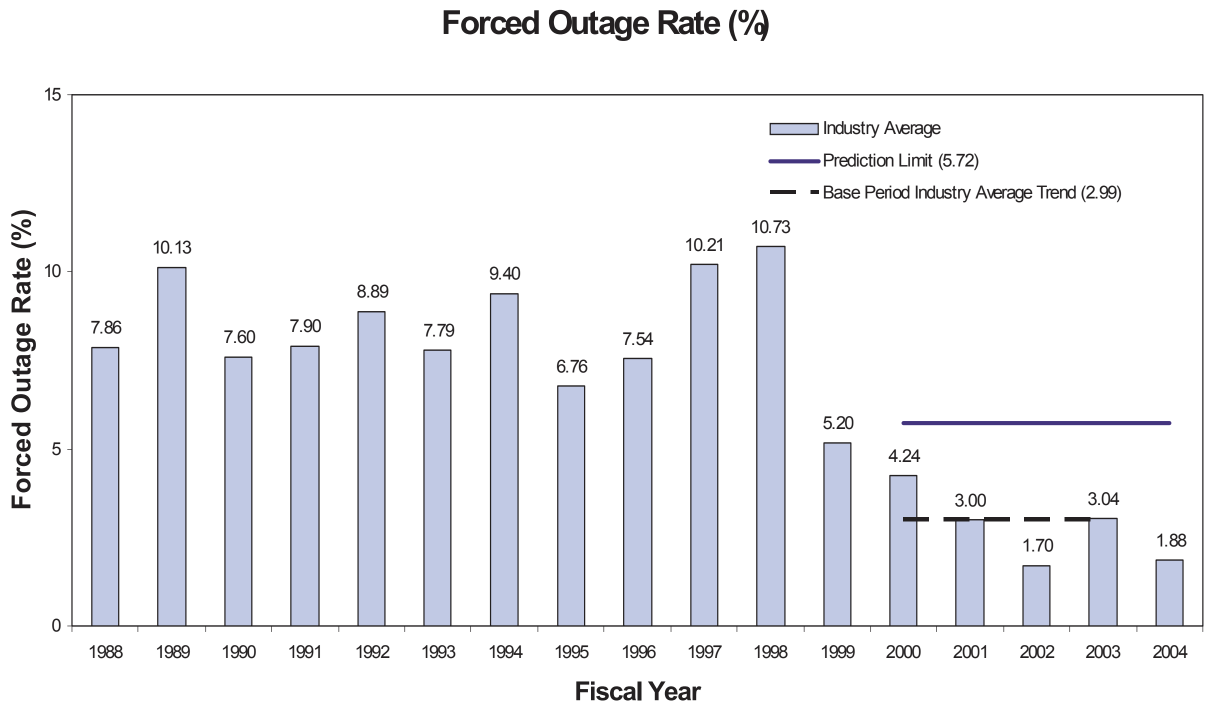

Figure A2-5

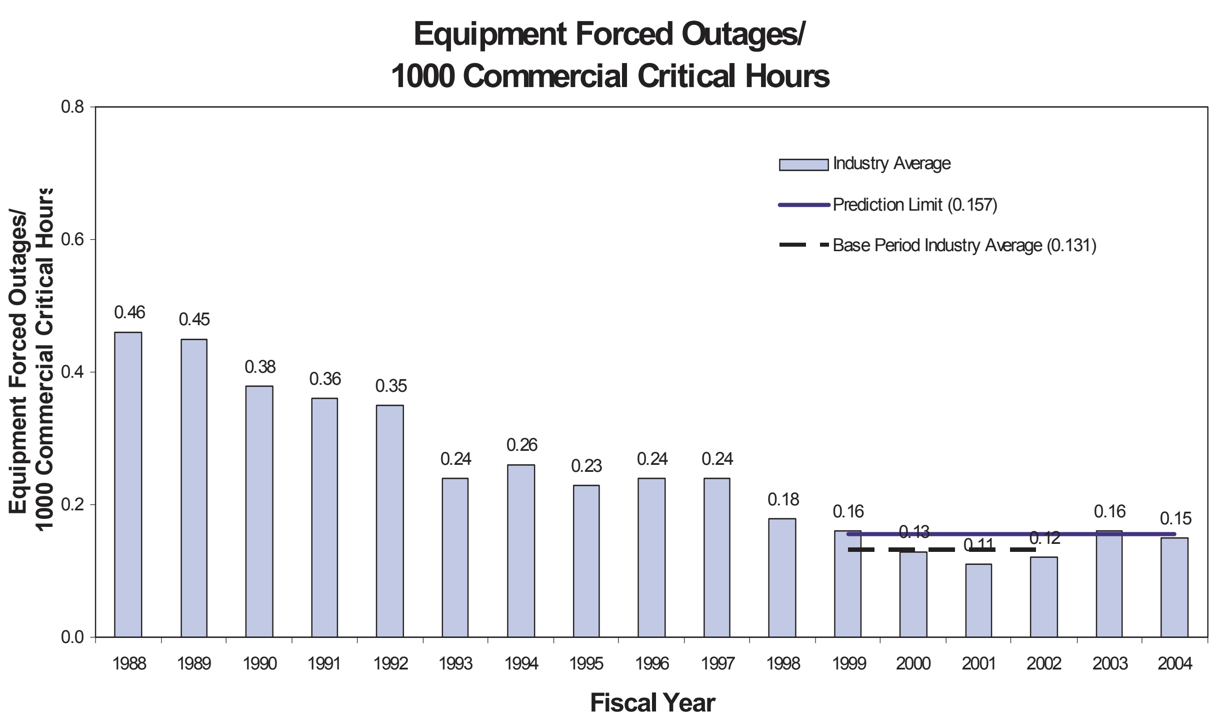

Figure A2-6

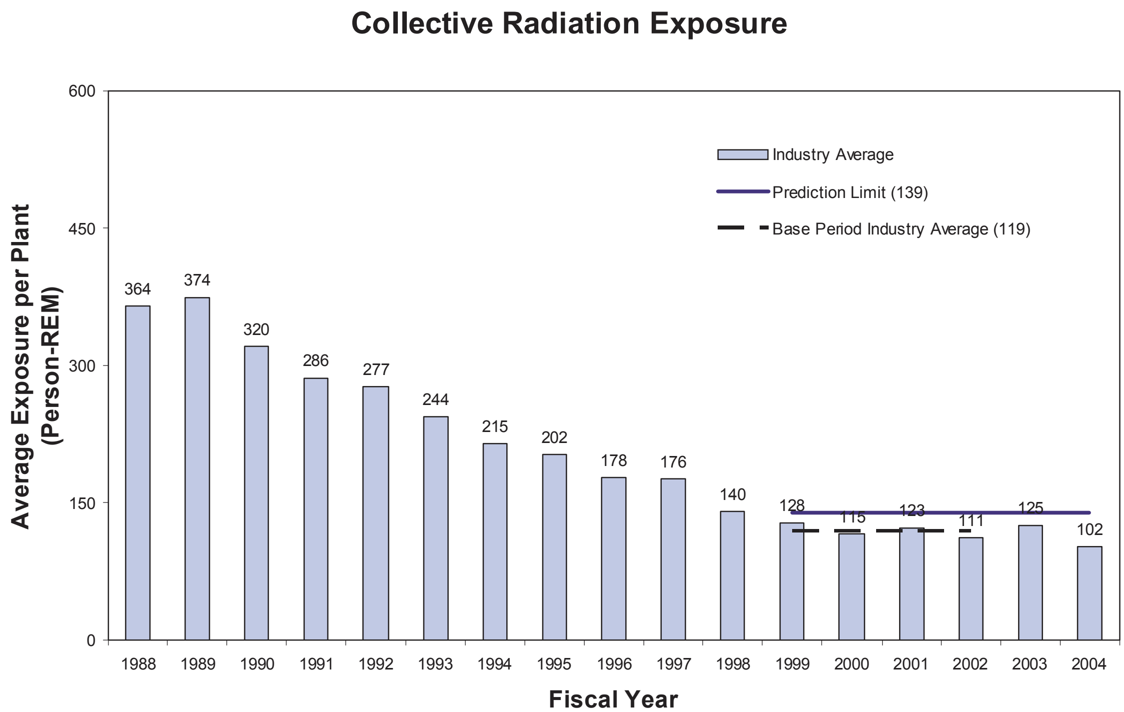
Collective Radiation Exposure
Average Exposure per Plant (Person-REM)
600
450
300
150
0
Industry Average
Prediction Limit (139)
Base Period Industry Average (119)
364
374
320
286
277
244
215
202
178
176
140
128
115
123
111
125
102
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Fiscal Year

Figure A2-7

FY 2004 Industry-Level Rollup of ROP PIs

Unplanned Scrams

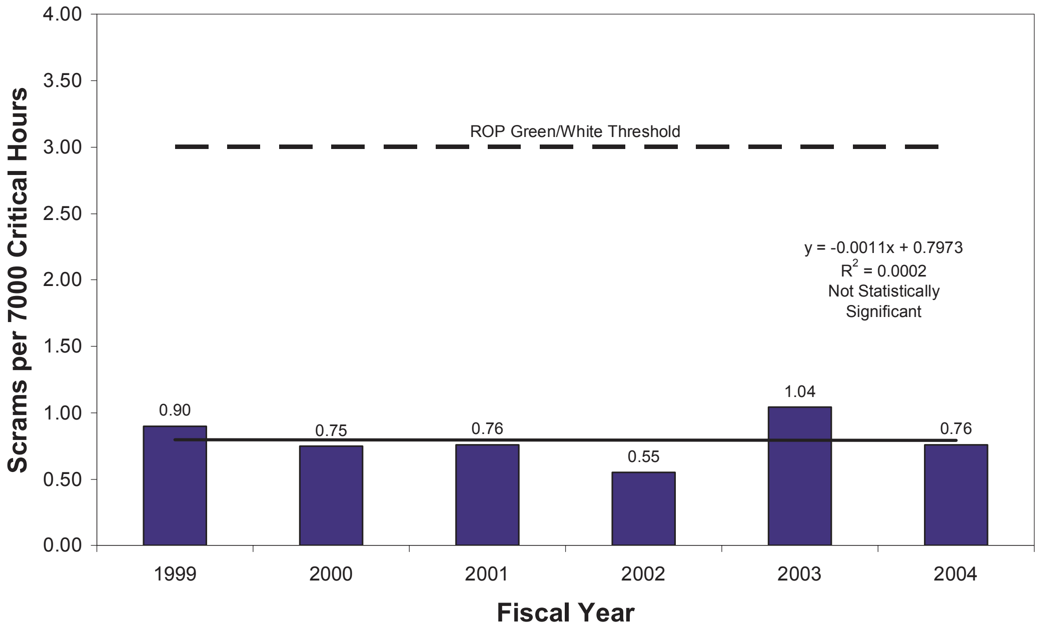

Figure A3-1

Scrams with Loss of Normal Heat Removal

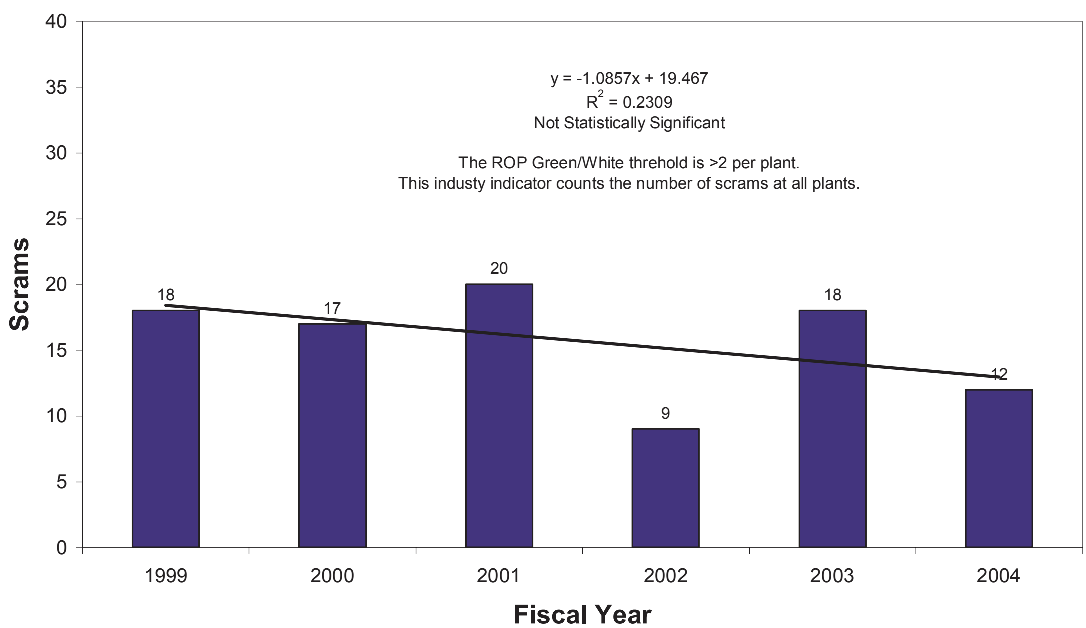

Figure A3-2

Note: Eight scrams from FY 2001—FY 2004 are currently being evaluated by the ROP Working Group to determine if they are scrams with loss of normal heat removal. Five of these scrams have not been reported in the ROP PI data, pending resolution by the working group, and as such are not included in this chart.

ATTACHMENT 3

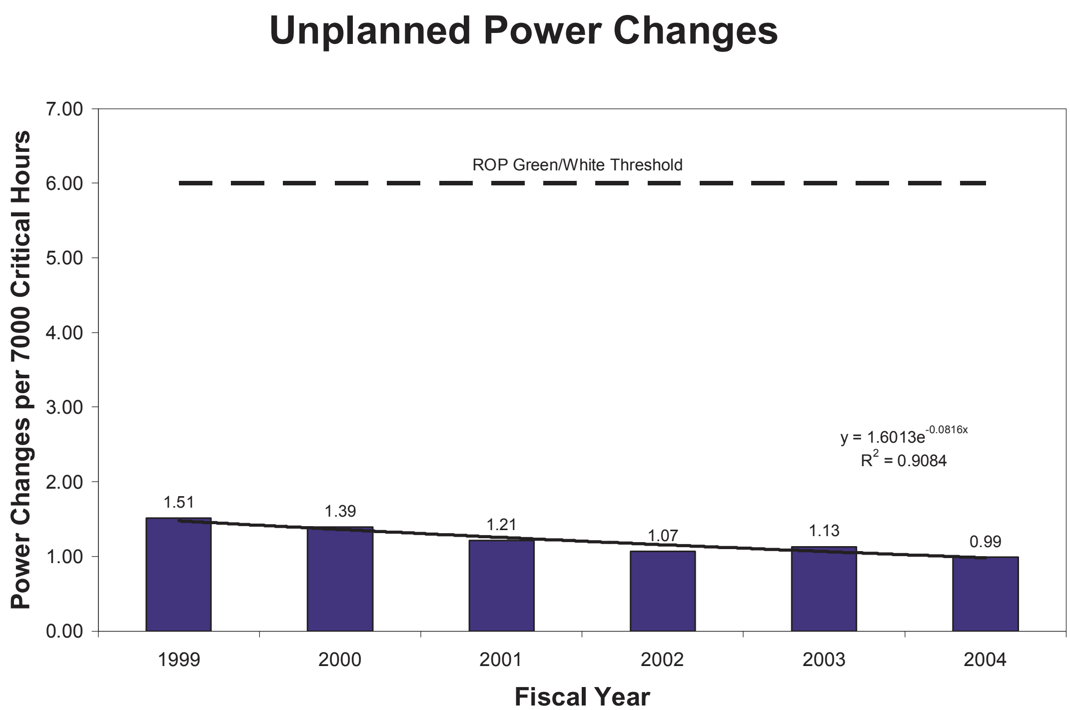

Figure A3-3

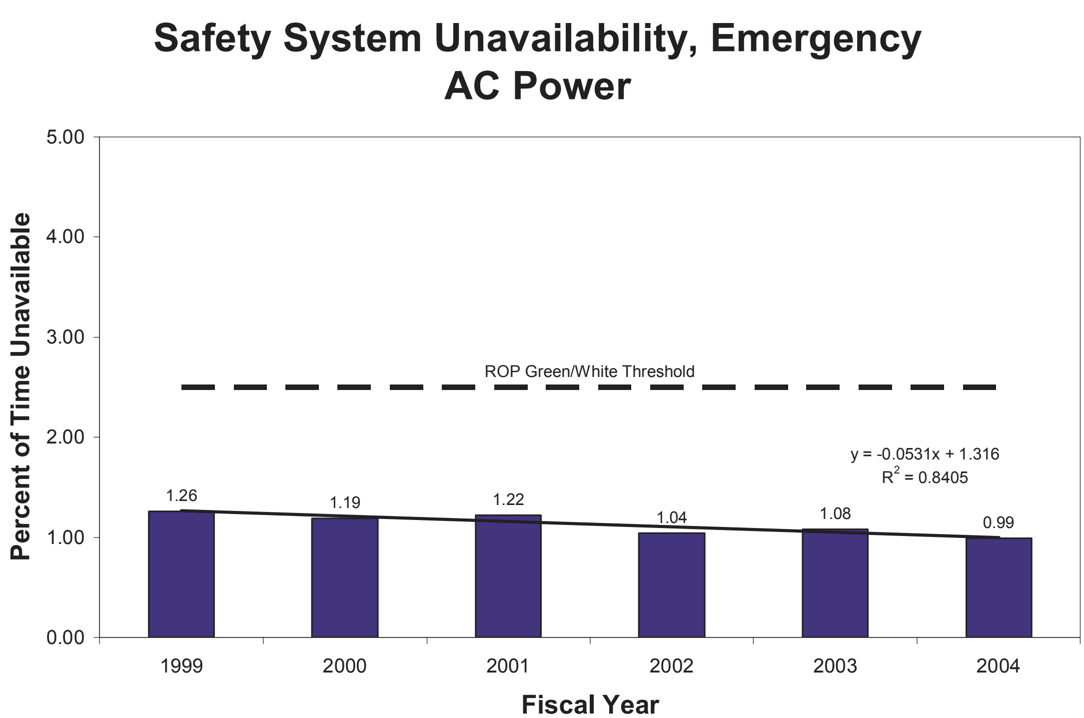

Figure A3-4

Safety System Unavailability, High Pressure Coolant Injection (HPCI)

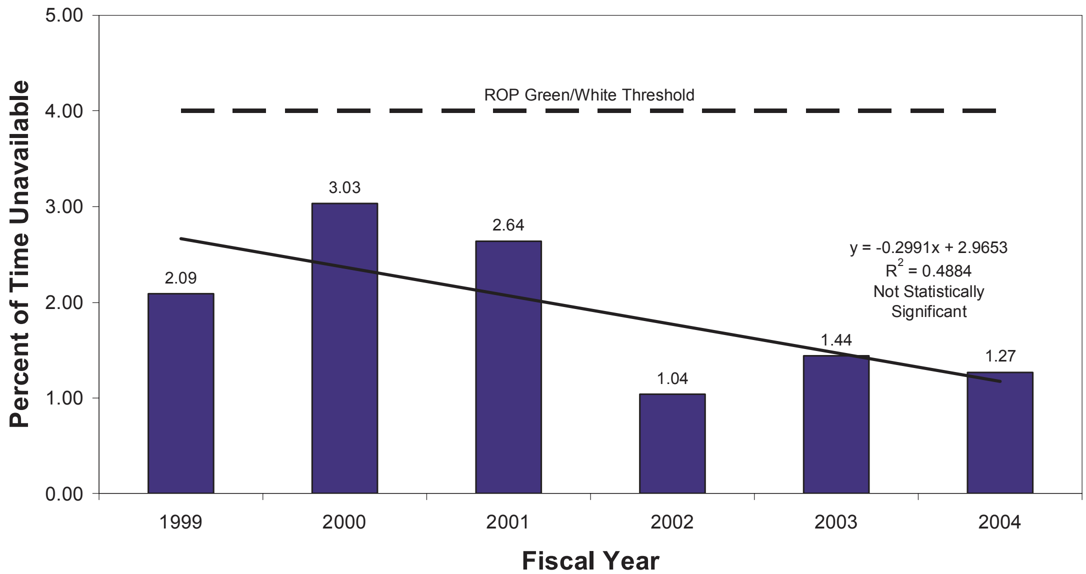

Figure A3-5

Safety System Unavailability, High Pressure Core Spray (HPCS)

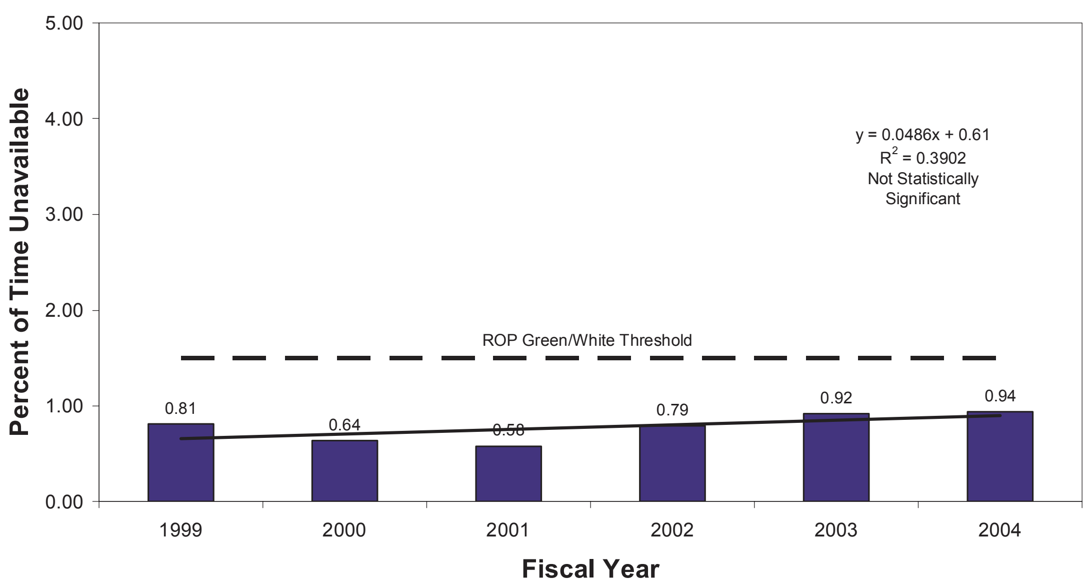

Figure A3-6

Safety System Unavailability, High Pressure Injection System (HPSI)

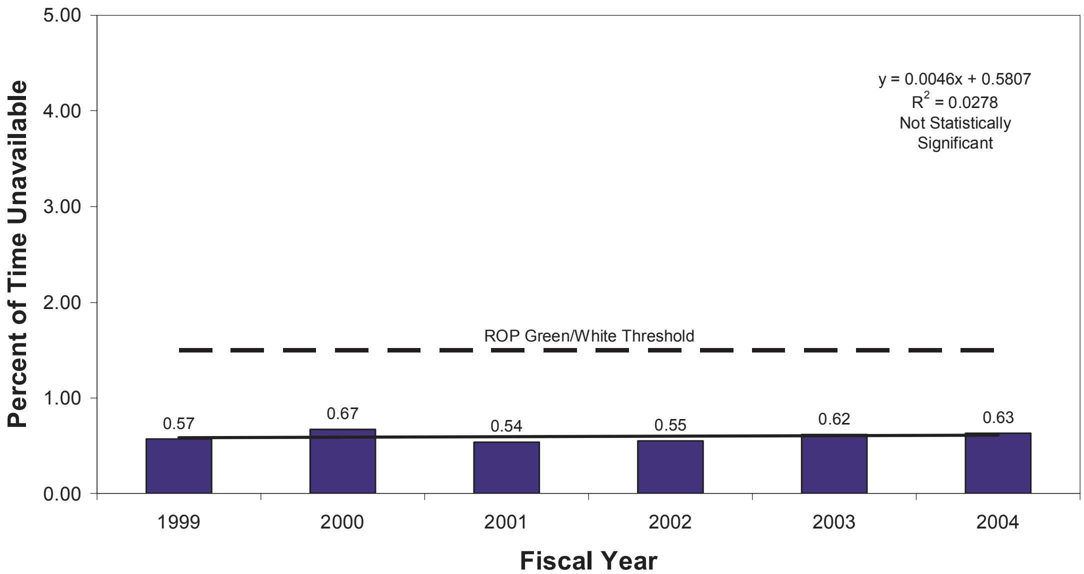

Figure A3-7

Safety System Unavailability, Heat Removal System (RCIC)

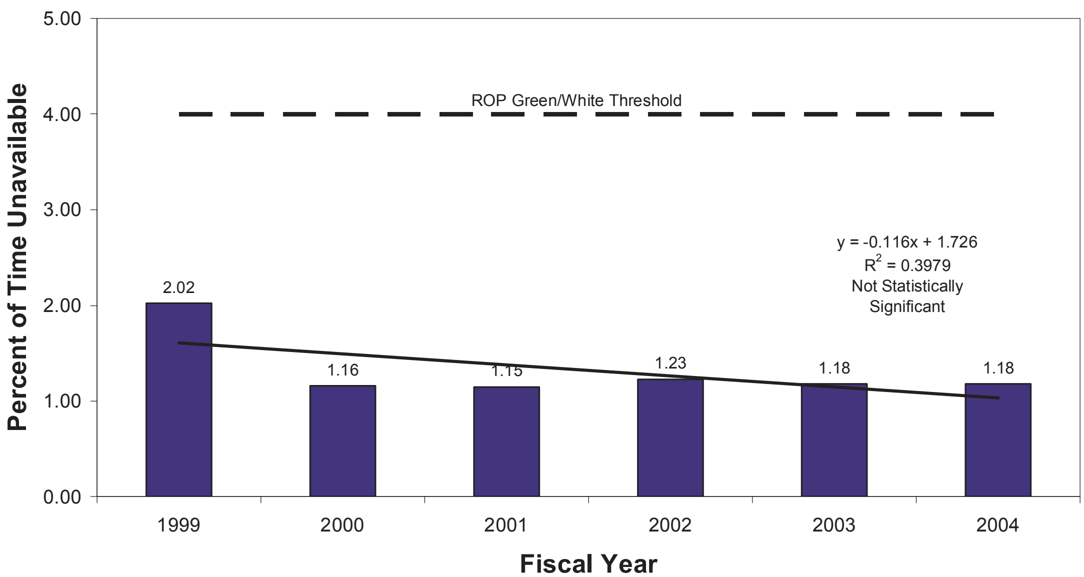

Figure A3-8

Safety System Unavailability, Heat Removal System (AFW)

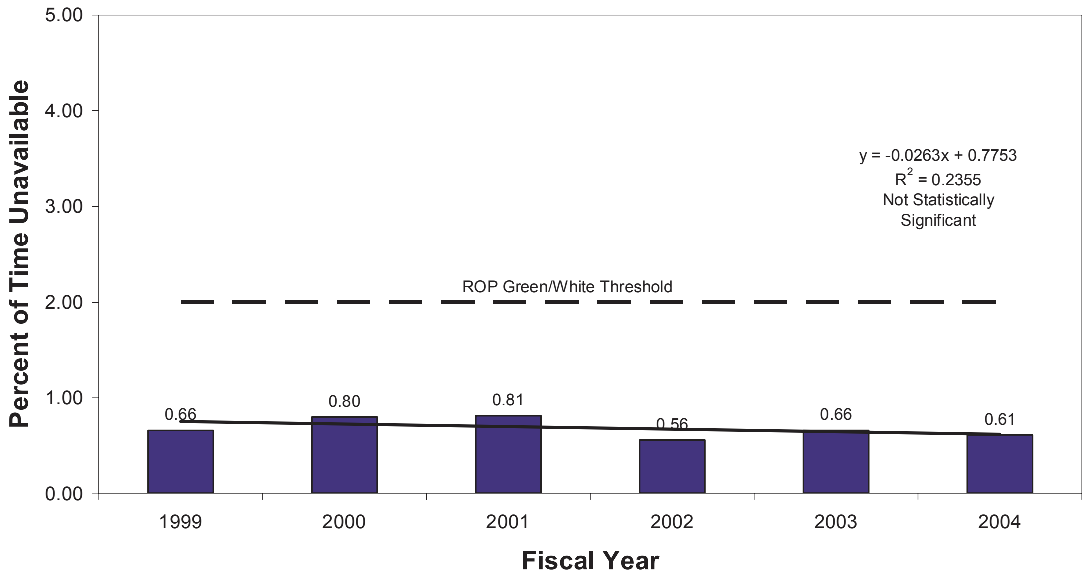

Figure A3-9

Safety System Unavailability, Residual Heat Removal System (BWR)

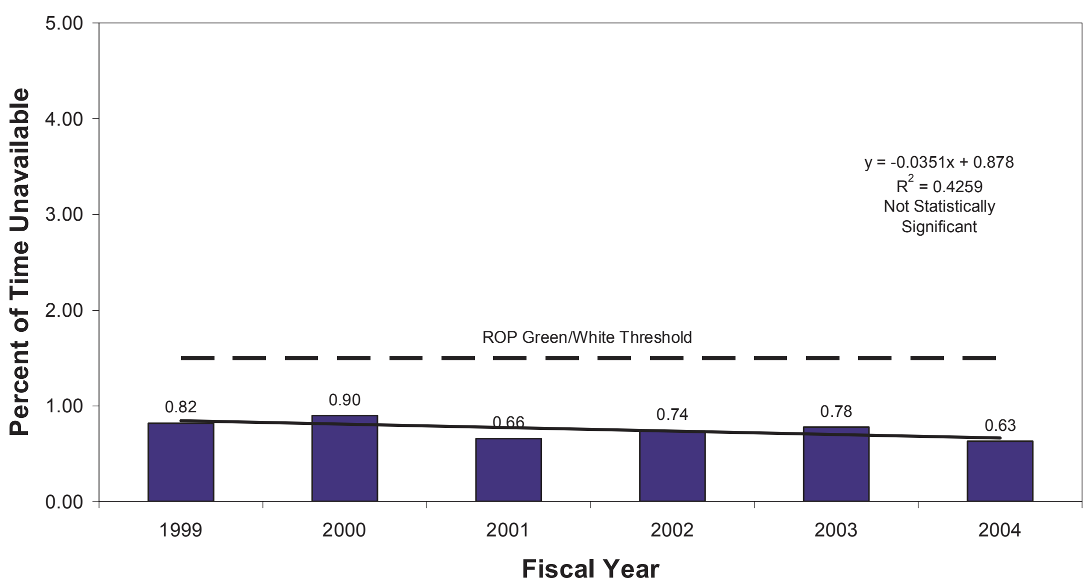

Figure A3-10

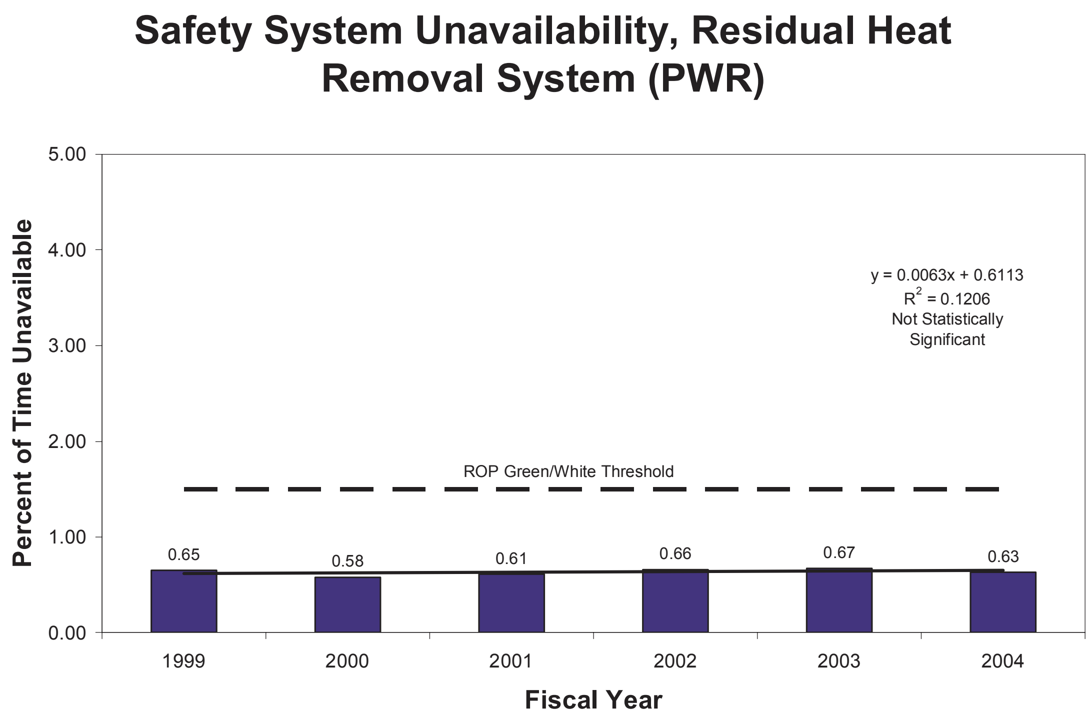

Figure A3-11

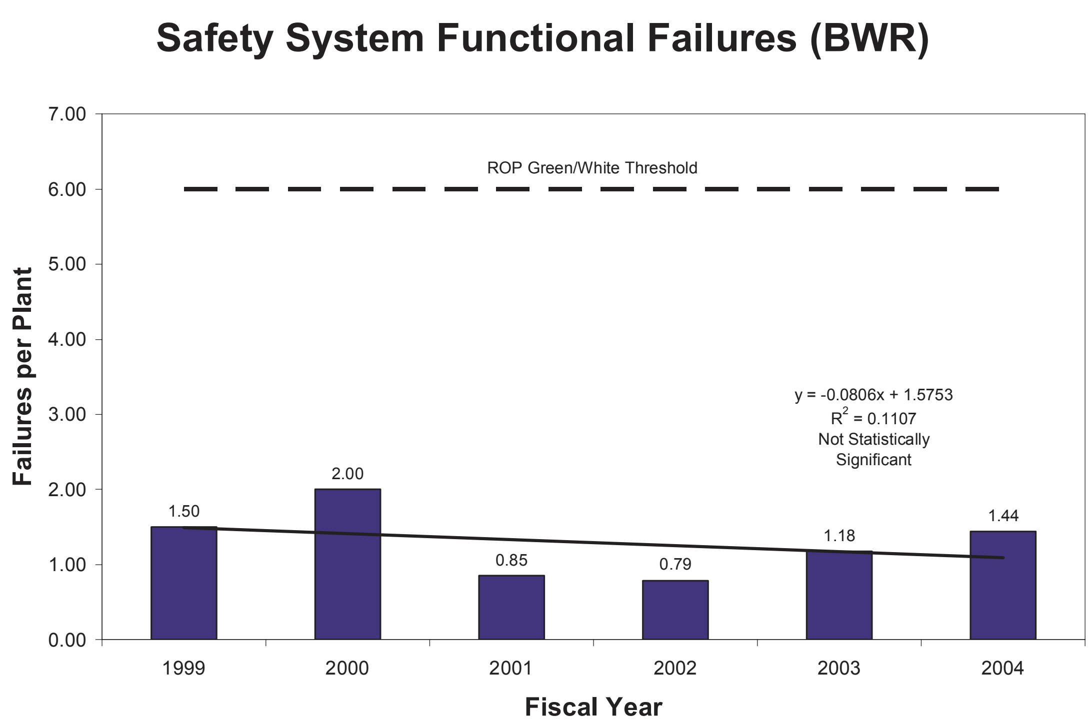

Figure A3-12

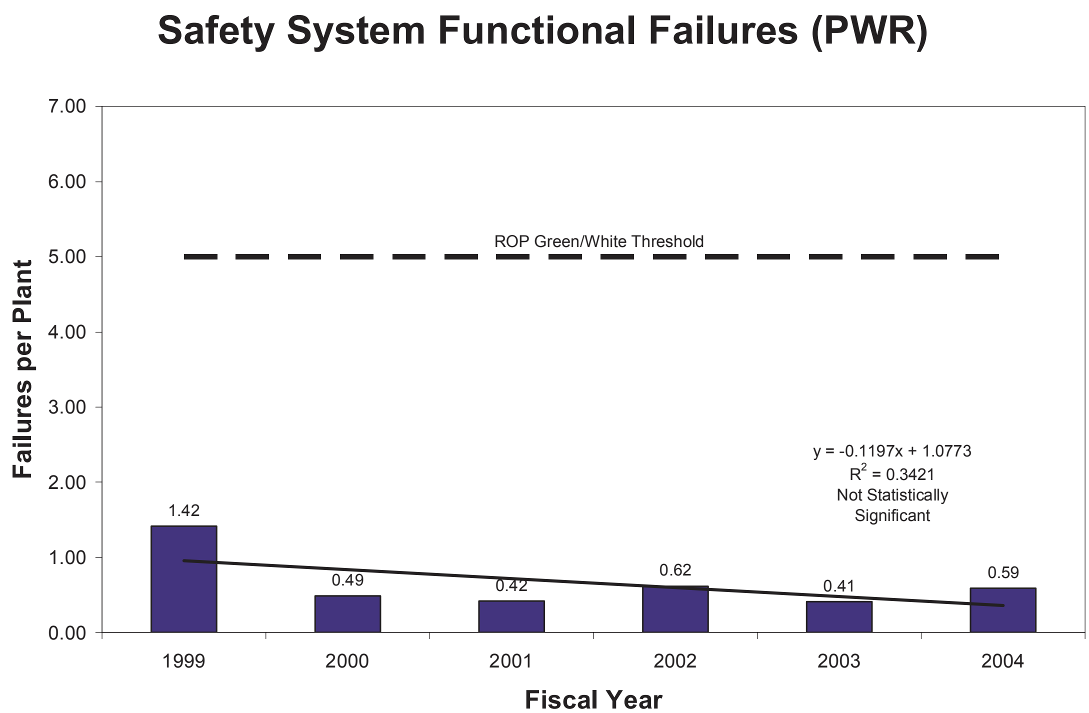

Figure A3-13

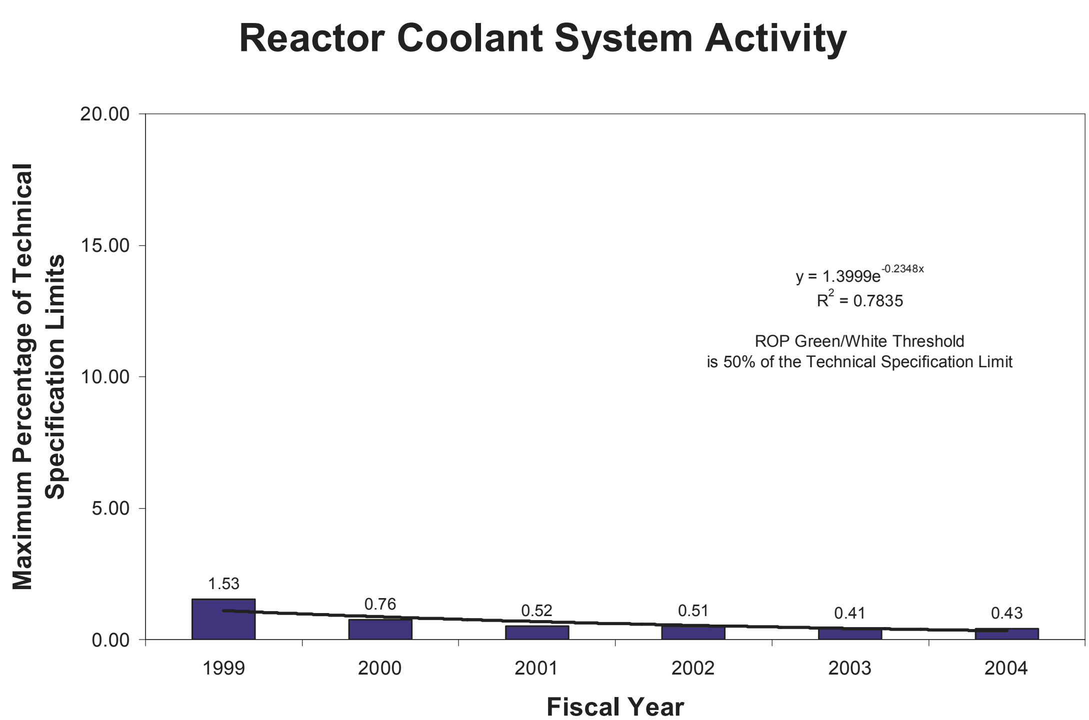

Figure A3-14

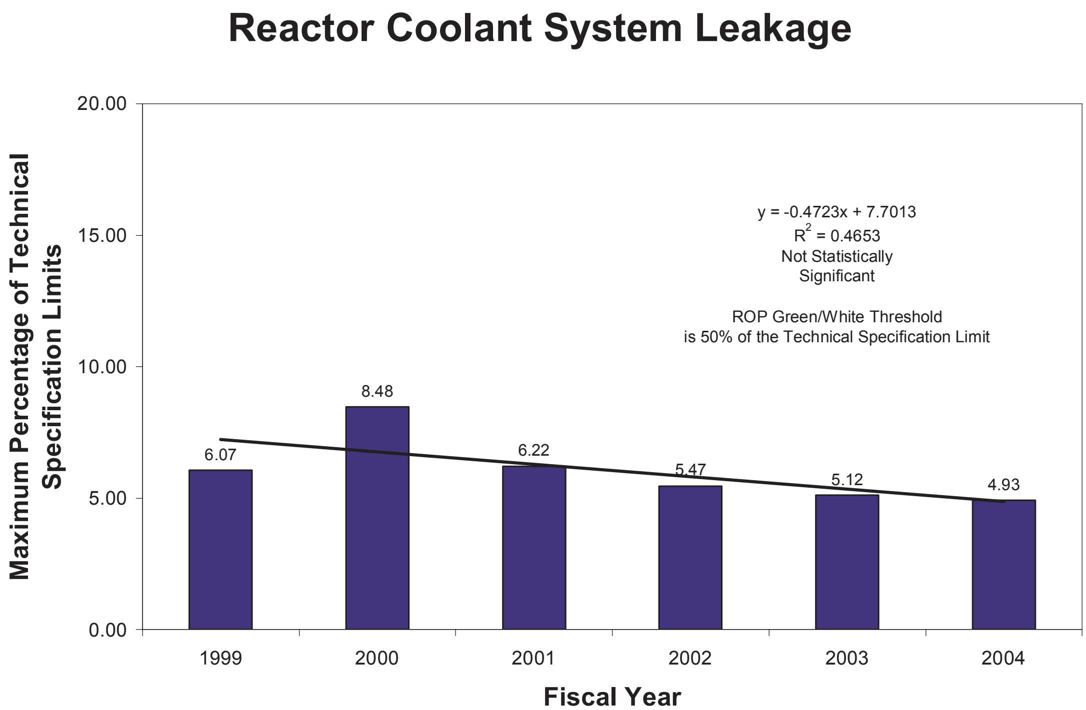

Figure A3-15

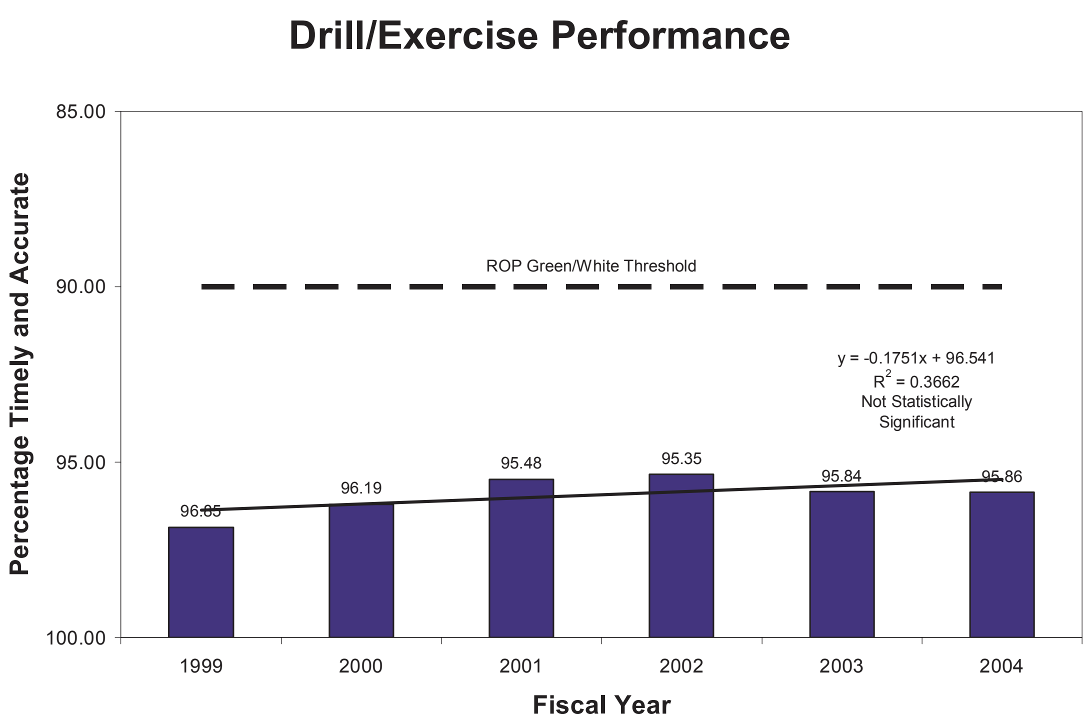

Figure A3-16

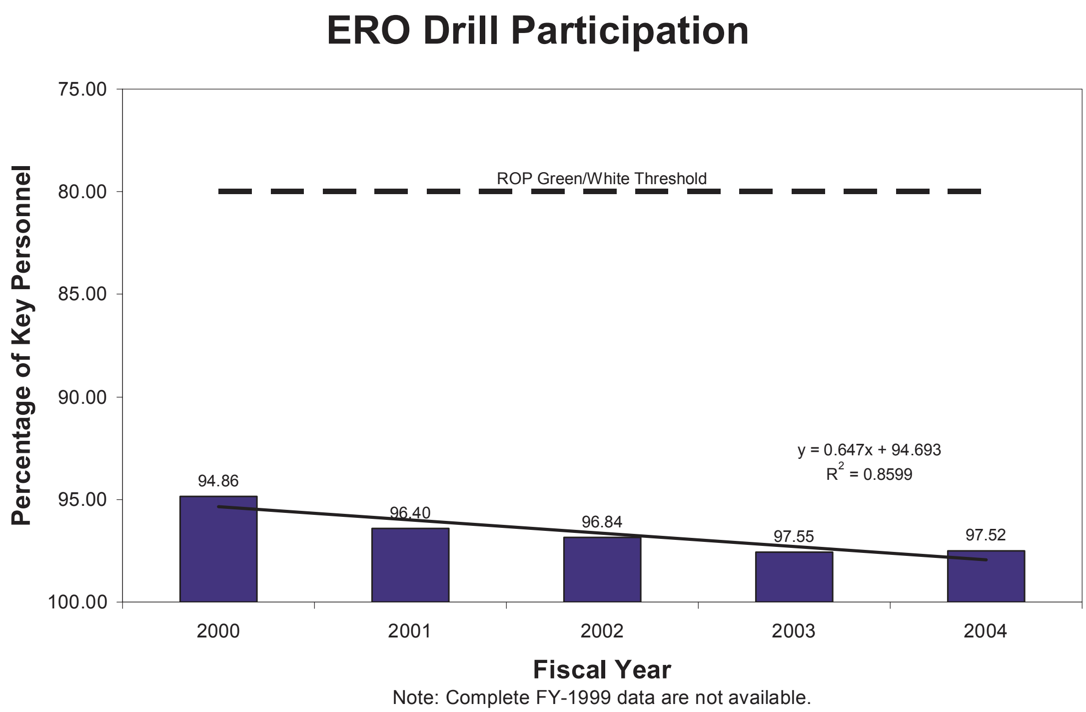

Figure A3-17

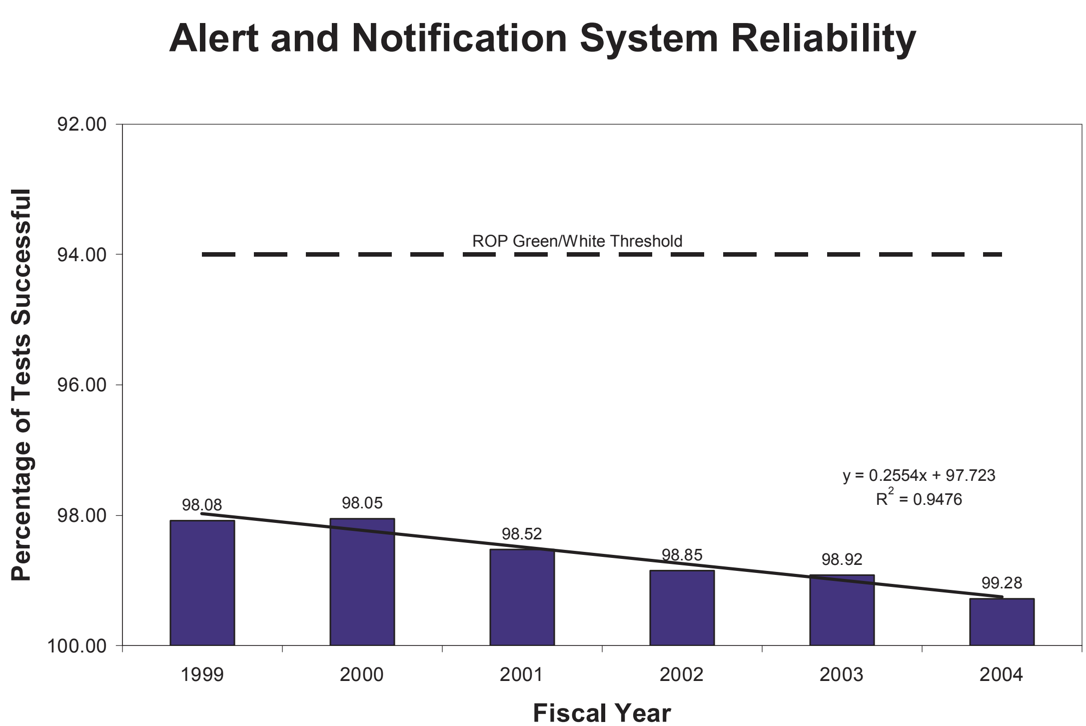

Figure A3-18

Occupational Exposure Control Effectiveness

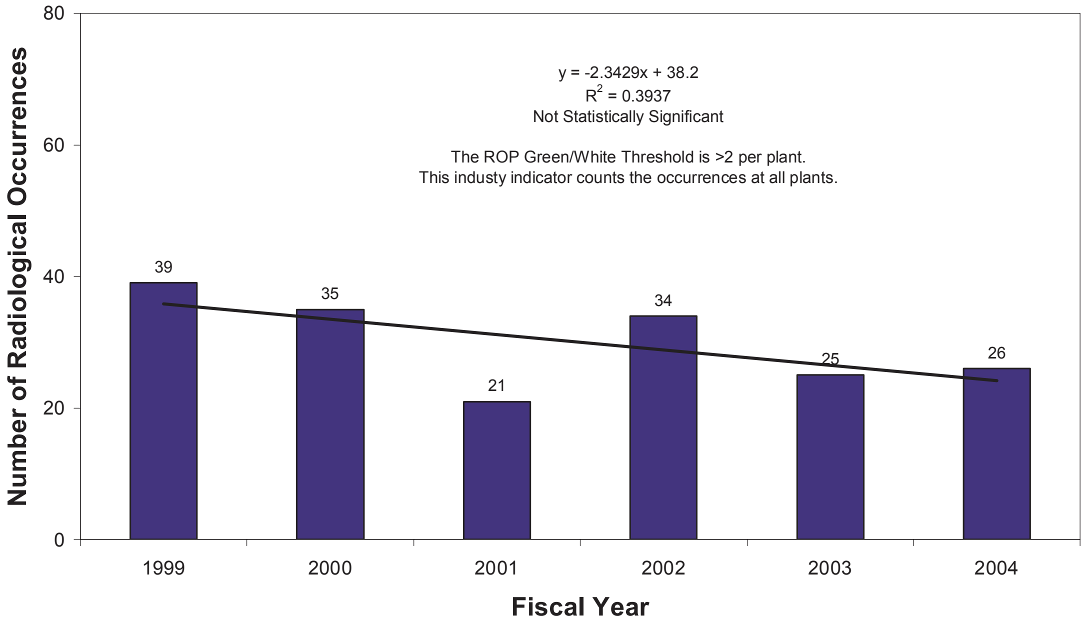

Figure A3-19

RETS/ODCM Radiological Effluent Occurrences

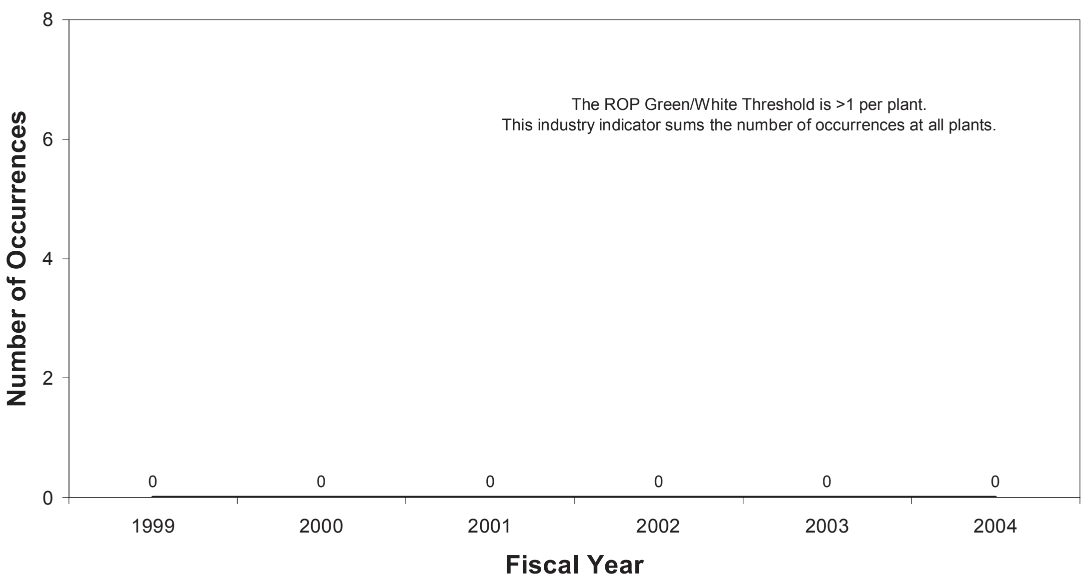

Figure A3-20

Summary of Industry Trends Program Process

Collect Indicator Data

In developing the Industry Trends Program (ITP), the staff used information currently available from existing NRC programs to develop an initial set of indicators for identifying adverse industry trends. The indicators consisted of the seven indicators used by the former NRC Office for Analysis and Evaluation of Operational Data (AEOD) and the results of the Accident Sequence Precursor (ASP) Program. In addition, the staff is developing more risk-informed industry-wide indicators using data from the 18 plant-level performance indicators submitted by licensees under the Reactor Oversight Process (ROP). The staff also identified potential indicators for initiating events that are anticipated to be available from operating experience data. These indicators are being consolidated into a Baseline Risk Index for Initiating Events (BRIIE).

Identify Short-Term Issues

In fiscal year 2001 NRR adopted a statistical approach using “prediction limits” to provide a consistent method to identify potential short-term emergent issues before they become long-term trends. The prediction limits are values established at the beginning of a fiscal year that set an upper bound on expected performance for that year for each indicator. Actual indicator values during the year can then be compared to the prediction limits. Indicators that exceed the prediction limits are investigated to determine the factors influencing the data. These factors are assessed for their safety significance and used to determine an appropriate agency response. However, if obvious adverse trends emerge in the short-term data, the staff does not wait until the end of the fiscal year to initiate a review.

Identify Adverse Trends

Only long-term data is used to assess whether there are any statistically significant adverse industry trends. The trending of long-term data minimizes reactions to potential “false positive” indications that emerge in short-term data. “Short-term” is defined as less than four years to ensure that sufficient data (i.e., data for at least two typical nuclear plant operating cycles) is available to use statistical methods and to distinguish valid trends from random fluctuations in the data and operating cycle effects such as refueling outages. The staff expects that any other variations in the data are due to plant-specific issues which can be addressed under the ROP.

The staff applies common statistical techniques to the long-term indicator data to identify trends. The staff has extensively used these techniques in reactor operating experience analyses. In general terms, a trendline is fitted to each indicator using regression techniques. The slope of the trendline is then examined. An improving or flat trendline is not considered adverse and need not be investigated further. A degrading trendline is considered adverse. Statistical analysis is conducted to determine if the trendline is statistically significant.

Analyze Issues

After identifying a statistically significant adverse trend, the staff conducts an initial analysis of information readily available in the databases of the indicator data to determine whether the trend is unduly influenced by a few outliers, and to identify any contributing factors. If the trend is the result of outliers, it is not considered a trend requiring generic actions, and the agency will consider appropriate plant-specific actions using the ROP. For example, the plants unduly influencing the adverse trend may have already exceeded plant-level thresholds under the ROP, and the NRC regional offices conduct supplemental inspections at these plants to ensure the appropriate corrective actions have been taken. If the plants did not exceed any thresholds, the NRC does not take regulatory actions beyond the ROP, but gathers additional information on the issue through the ROP using risk-informed baseline inspections. The results of these inspections are examined to determine if a generic issue exists requiring additional NRC review or generic inspections.

If no outliers are identified, the staff conducts a broader review to assess whether larger groups of facilities are contributing to the decline and to assess any contributing factors and causes. For example, the data review is expanded to include a review of various plant comparison groups, contributing factors such as the operational cycle stage of the facilities (shutdown, at-power, startup from refueling, etc.), and the apparent causes for the data (equipment failures, procedure problems, etc.). The staff also conducts a more detailed review of applicable licensee event reports. If a group of plants is identified, the staff examines the results of previous inspections at these plants, including the root causes and the extent of the conditions.

The staff then assesses the safety significance of the underlying issues. The staff is aware that trends in individual indicators must be considered in the larger context of their overall risk significance. For example, a hypothetical increase in automatic scrams from 0.4 to 0.7 per plant per year over several years may be a statistically significant trend in an adverse direction. However, it may not represent a significant increase in overall risk since the contribution of a few scrams is relatively low, and the overall risk may actually have declined if there have been reductions in the frequency of the more risk-significant initiating events or the reliability and availability of safety systems has improved. Depending on the issue, the staff may perform an additional evaluation using the most current risk analysis tools or an evaluation may be done by the ASP Program.

Agency Response

If a statistically significant adverse trend in safety performance is identified or an indicator crosses a prediction limit, the staff determines the appropriate response using the NRC's established processes for addressing and communicating generic issues. These processes are described in SECY-99-143, “Revisions to Generic Communications Program.”

In general, the issues are assigned to the appropriate branch of NRR for initial review. The branch engages NRC senior management and initiates early interaction with the nuclear power industry. Depending on the issue, the agency may ask industry groups such as NEI and owners groups to provide utility information. As discussed in SECY-00-0116, “Industry Initiatives in the Regulatory Process,” industry initiatives, such as the formation of specialized working groups to address technical issues, may be used in lieu of, or to complement, regulatory actions. This can benefit both the NRC and the industry by identifying mutually satisfactory resolution approaches and reducing resource burdens.

Depending on the issues, the NRC may consider generic safety inspections at plants. In addition, RES may address the issues underlying the adverse trend as part of the generic safety issue process. The NRC may also consider additional regulatory actions as appropriate, such as issuing generic correspondence to disseminate or gather information or conducting special inspections for generic issues. The NRC may also implement changes to the inspection and licensing programs if necessary. The process also includes consideration of whether any actions proposed by the NRC to address the issues constitute a backfit.

Senior Management Review

The industry trends program, results, and agency responses are reviewed annually during the Agency Action Review Meeting (AARM). In general, the AARM reviews the appropriateness and effectiveness of staff actions already taken, rather than deciding on agency actions. NRC senior managers review the industry trends information and, if appropriate, recommend any additional actions beyond those implemented by the staff.

Communicating With Stakeholders

The NRC communicates overall industry performance to stakeholders by publishing the ITP indicators on the agency's public Web site at *http://www.nrc.gov/reactors/operating/oversight/industry-trends.html*. The staff believes that communication of the industry-level indicators, together with the information on individual plants from the ROP, enhances stakeholder confidence in the effectiveness of the NRC's oversight of the nuclear industry.

The staff informs the Commission of the results of the ITP in an annual report in the same timeframe as the AARM. The indicators are also published annually in the NRC's "Information Digest 200X" (NUREG-1350 series). In addition, NRC managers have historically presented industry indicators and trends at major conferences with industry.

Reporting to Congress

The NRC reports the industry indicators to Congress annually in the NRC's "Performance and Accountability Report, Fiscal Year 200X" (NUREG-1542 series) and in the NRC's "Budget Estimates and Performance Plan, Fiscal Year 200X" (NUREG-1100 series). The indicators demonstrate how successfully the agency has met the performance goal measure of "statistically significant adverse industry trends in safety performance" for maintaining safety. Statistically significant adverse trends are reported, but indicators that exceeded prediction limits need not be included in these reports since the prediction limits are tools for monitoring industry performance rather than desired thresholds of performance.

The Commission has historically used the ITP indicators in presenting the status of industry performance to the NRC's oversight committees.