POLICY ISSUE
(Information)

March 27, 2008 SECY-08-0041

FOR: The Commissioners

FROM: Luis A. Reyes
Executive Director for Operations

SUBJECT: FISCAL YEAR 2007 RESULTS OF THE INDUSTRY TRENDS PROGRAM FOR OPERATING POWER REACTORS AND STATUS OF THE ONGOING DEVELOPMENT OF THE PROGRAM

PURPOSE:

The purpose of this paper is to inform the Commission of the results of the U.S. Nuclear Regulatory Commission (NRC) Industry Trends Program (ITP) for fiscal year (FY) 2007 and the status of ongoing program development.

BACKGROUND:

The NRC staff implemented the ITP in 2001. The NRC uses industry-level indicators to monitor for adverse trends. After assessing adverse trends for safety significance, the NRC responds as necessary to any identified safety issues, including adjusting 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 Performance and Accountability Report (PAR). In addition, the NRC annually reviews the results of the ITP and any actions taken or planned during the Agency Action Review Meeting and reports the findings of this review to the Commission. This paper is the seventh annual report to the Commission on the ITP.

CONTACT: A. Masciantonio, NRR/DIRS
301-415-1290

NRC Inspection Manual Chapter (IMC) 0313, “Industry Trends Program,” contains ITP details, including definitions of indicators monitored and program descriptions.

DISCUSSION:

Using the ITP, the staff monitors industry safety performance to identify and address adverse industry trends. The indicators are comprehensive and based on the best available data. An adverse trend exists if the slope of the regression line fitted to the long-term indicator data is a positive value.

In addition to the long-term indicators, the ITP also uses precursor events identified by the accident sequence precursor (ASP) program to assess industry performance. The occurrence rate of precursors is analyzed to determine if an adverse trend exists.

The ITP uses the ASP results as one of the agency’s monitored indicators. The NRC provides the results of the ITP in the PAR and performance budget documents.

The ITP monitors industry-level performance. The Reactor Oversight Process (ROP) provides oversight of individual plant conditions and events.

RESULTS OF FY 2007 TREND ANALYSES

Based on the ITP indicators and the ASP program results, the staff did not identify any statistically significant adverse trends in industry safety performance through the end of FY 2007. The graphs in Enclosure 1 show the long-term ITP indicator trends and the ASP precursor data.

The ASP program considers an event with a conditional core damage probability (CCDP) or increase in core damage probability (ΔCDP) greater than or equal to 1×10^{-6} to be a precursor.

The graph depicting the occurrence rate of total precursors by fiscal year, on page 8 of Enclosure 1, shows the occurrence rate for all precursors by FY during the period FY 2001 - FY 2006. A review of the data for that period reveals that (1) the mean occurrence rate of all precursors does not exhibit a trend that is statistically significant for the period FY 2001 - FY 2006, and (2) the analysis detected a statistically significant decreasing trend for precursors with a CCDP or ΔCDP greater than or equal to 1×10^{-4} during this same period. The staff chose FY 2001 as the starting point for trend analyses to provide a data period with a consistent ASP program scope and to align it with the first full year of the ROP. ASP program changes in FY 2001 (e.g., inclusion of significance determination process findings and external initiated events) significantly increased the number of precursors identified compared to those identified in previous years. The data period for trending analyses ends in FY 2006 (the last full year of completed ASP analyses) but will become a rolling 10-year period in the future.

The ASP program also provides the basis for the FY 2006 performance goal measure of “zero events per year identified as a *significant* precursor of a nuclear accident”—one measure associated with the safety goal established in the NRC’s Strategic Plan. A *significant* precursor is an event that has a probability of at least 1 in 1,000 (greater than or equal to 1×10^{-3}) of leading to a reactor accident. A review of the data reveals that the mean occurrence rate of

significant precursors does not exhibit a statistically significant trend for the period FY 2001 - FY 2007. The staff identified no *significant* precursors in FY 2007.

The staff reported the results of the ASP program to the Commission in SECY-07-0176, "Status of the Accident Sequence Precursor Program and the Development of Standardized Plant Analysis Risk Models," dated October 3, 2007.

In addition to the long-term trend monitoring, the staff uses a statistical approach based on prediction limits to identify potential short-term, year-to-year emergent issues before they become long-term trends. Enclosure 2 shows the short-term trends and the prediction limits for each of the ITP indicators. Short-term trending of the FY 2007 data did not identify any issues that warranted additional analysis or significant adjustments to the nuclear reactor safety inspection or licensing programs. However, in the ROP self-assessment Commission paper for calendar year 2007, the staff noted a possible declining trend in industry performance as evidenced by an increase in the number of sites in Column 3 and 4 of the ROP Action Matrix. The staff plans to further assess ITP and ROP data as well as engage with internal and external stakeholders to better understand this information.

ITP DEVELOPMENT

Current ITP performance indicators have both strengths and weaknesses. Strengths include the availability of historical results, continuity and consistency in yearly evaluations, and broad coverage of the cornerstones of safety. However, weaknesses in the initiating events and mitigating systems cornerstones of safety include (1) overlapping coverage, (2) limited risk coverage, and (3) difficulties in interpreting the risk significance of important adverse trends.

As a first step in enhancing the ITP to address these weaknesses, the staff chose the initiating event cornerstone of safety as the area of focus. Work focused on the development of performance indicators that did not overlap in coverage, significantly increased the risk coverage, and provided a mechanism for determining the risk significance of changes in performance, at both the individual initiating event level and at the integrated cornerstone of safety level.

In FY 2007, the staff completed the development of the Baseline Risk Index for Initiating Events (BRIIE), an indicator that monitors 9 risk-significant initiating events for boiling-water reactors and 10 events for pressurized-water reactors (the additional event category is steam generator tube rupture). The indicator weights each initiating event according to its relative contribution to industry core damage frequency. The staff reported the status of BRIIE development in SECY-07-0063, "Fiscal Year 2006 Results of the Industry Trends Program for Operating Reactors and Status of the Ongoing Development of the Program," dated April 3, 2007. In its staff requirements memorandum (SRM), "Briefing on Results of the Agency Action Review Meeting (AARM)—Reactors," dated June 14, 2007, the Commission directed that "the staff should provide to the Commission for approval a paper that describes the Baseline Risk Index for Initiating Events and plans for its use as a new industry-wide indicator. As part of this paper, the staff should discuss its communication plan."

The Commission paper describing the BRIIE and the related communication plan appeared as SECY-07-0184, "Industry Trends Program for Operating Power Reactors—Baseline Risk Index for Initiating Events," dated October 22, 2007. In this paper, the staff requested Commission

approval to implement the BRIIE as a new performance indicator for the ITP. In its SRM of December 21, 2007, related to SECY-07-0184, the Commission approved the staff's recommendation to implement the BRIIE. However, the Commission directed the staff to develop a public communication strategy to explain the meaning of the BRIIE, its underlying concept, and its intended use before making the information publicly available and before beginning the practice of reporting the BRIIE results to Congress. The Commission also directed that, when making the BRIIE publicly available, the staff should provide supporting data where appropriate and update the NRC public Web site on industry trends to discuss the BRIIE.

The staff is currently implementing these directives. With assistance from the Office of Public Affairs and the Center for Communications in the Office of the Executive Director for Operations, the staff has drafted a clear, plain-English, reader-friendly description of the BRIIE for the NRC public Web site. The staff has also drafted revisions to the NRC IMC 0313 that incorporate the BRIIE. These initiatives will be completed by May 2008.

NUREG/CR-6932 (INL/EXT-06-11950), "Baseline Risk Index for Initiating Events (BRIIE)," issued June 2007, provides historical results and the technical basis for the BRIIE. The staff will provide initial results for BRIIE in the Commission ITP paper issued in early 2009.

COMMITMENTS:

In SECY-07-0063, the staff committed to incorporate the BRIIE concept into NRC IMC 0313 and to formally report BRIIE results as an ITP indicator in this Commission paper; however, both of these activities were delayed in response to Commission direction as described above. The staff had previously also committed in SECY-06-0076, "FY 2005 Results of the Industry Trends Program for Operating Power Reactors and Status of the Ongoing Development of the Program," dated March 31, 2006, to revise IMC 0313 to include a process to ensure that the count of significant events includes revised and updated significant events data. The staff delayed this change to IMC 0313 in order to include the BRIIE at the same time; however, the staff used the new process in FY 2007. The next revision to IMC 0313 will address both the new process and the BRIIE concept.

RESOURCES:

In FY 2008, approximately 0.5 full-time equivalent staff (FTE) and $450,000 are needed for ongoing ITP implementation. The budget currently includes these resources. For FY 2009, approximately 0.5 FTE and $475,000 for contractor support are needed and are included in the FY 2009 budget request as part of the ROP in Planned Activity 122148. The NRC Office of Nuclear Regulatory Research (RES) completed work in direct support of the BRIIE in FY 2007. RES provides indirect support to the ITP in the areas of operating experience data and models developed and budgeted under other RES programs such as the simplified plant analysis risk program, the ASP program, and the reactor operating experience data collection and analysis program. The resources budgeted in the Office of Nuclear Reactor Regulation 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.

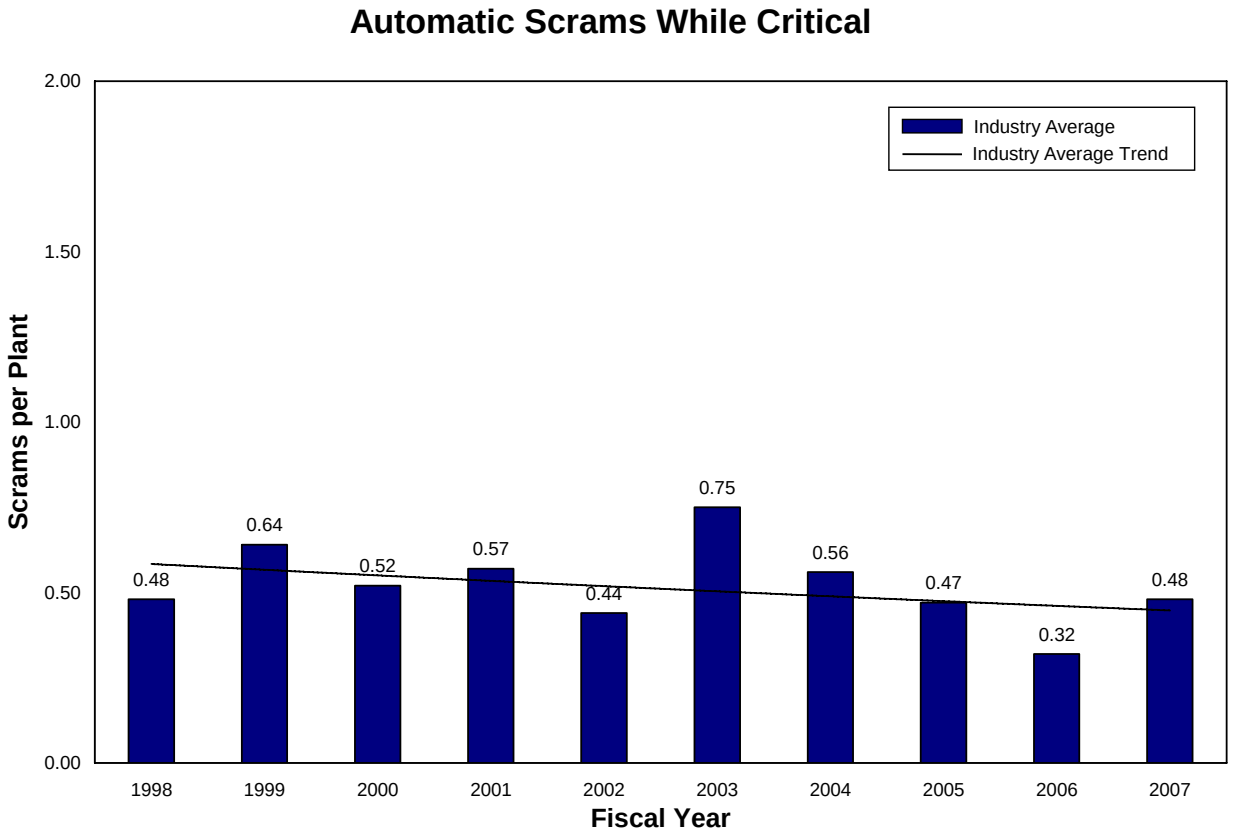
/RA/

Luis A. Reyes
Executive Director
for Operations

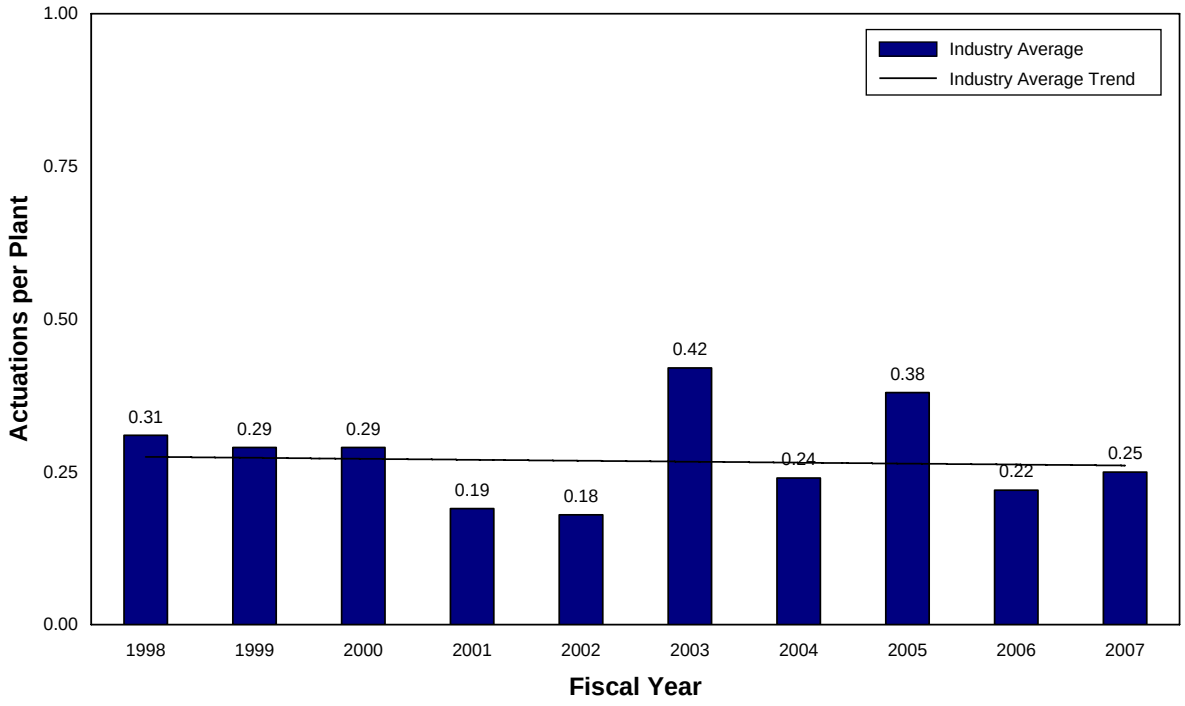
Enclosures:
1. Fiscal Year 2007 Long-Term Industry Trends Results
2. Fiscal Year 2007 Short-Term Industry Trends Results

FISCAL YEAR 2007 LONG-TERM INDUSTRY TRENDS RESULTS

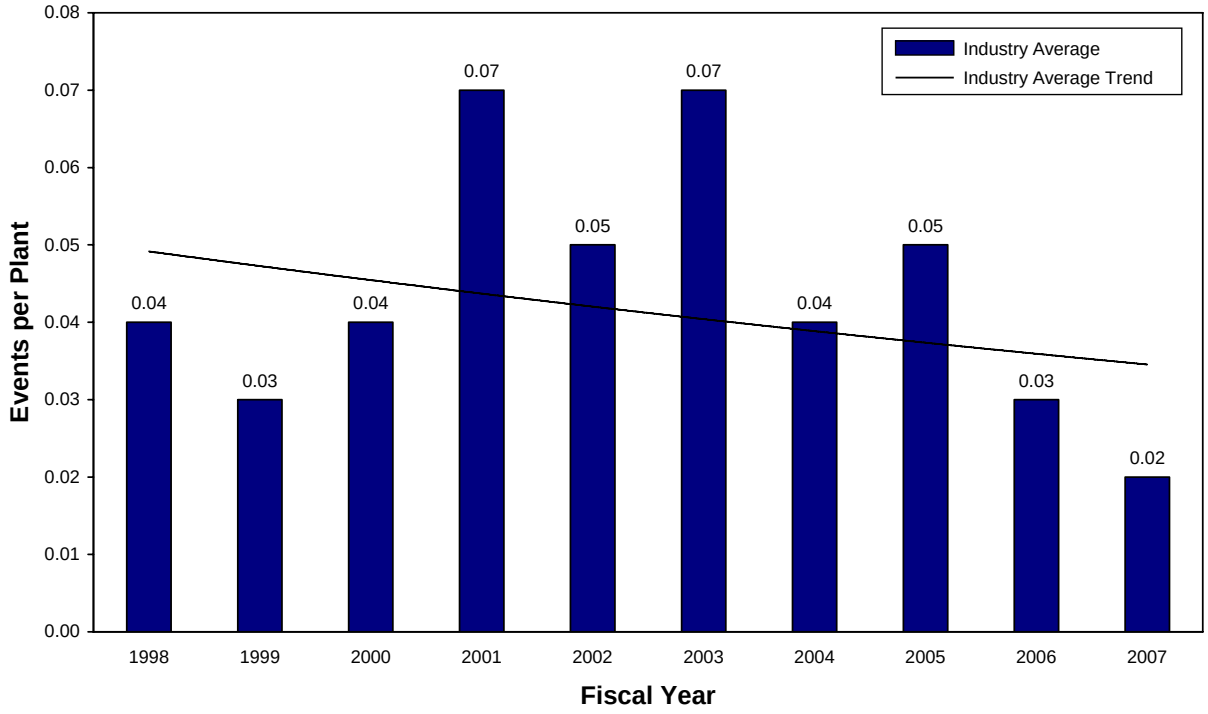
No statistically significant adverse trends were observed in the Industry Trends Program performance indicator data from the most recent 10 years (fiscal year (FY) 1998 to FY 2007) as indicated by the following graphs.



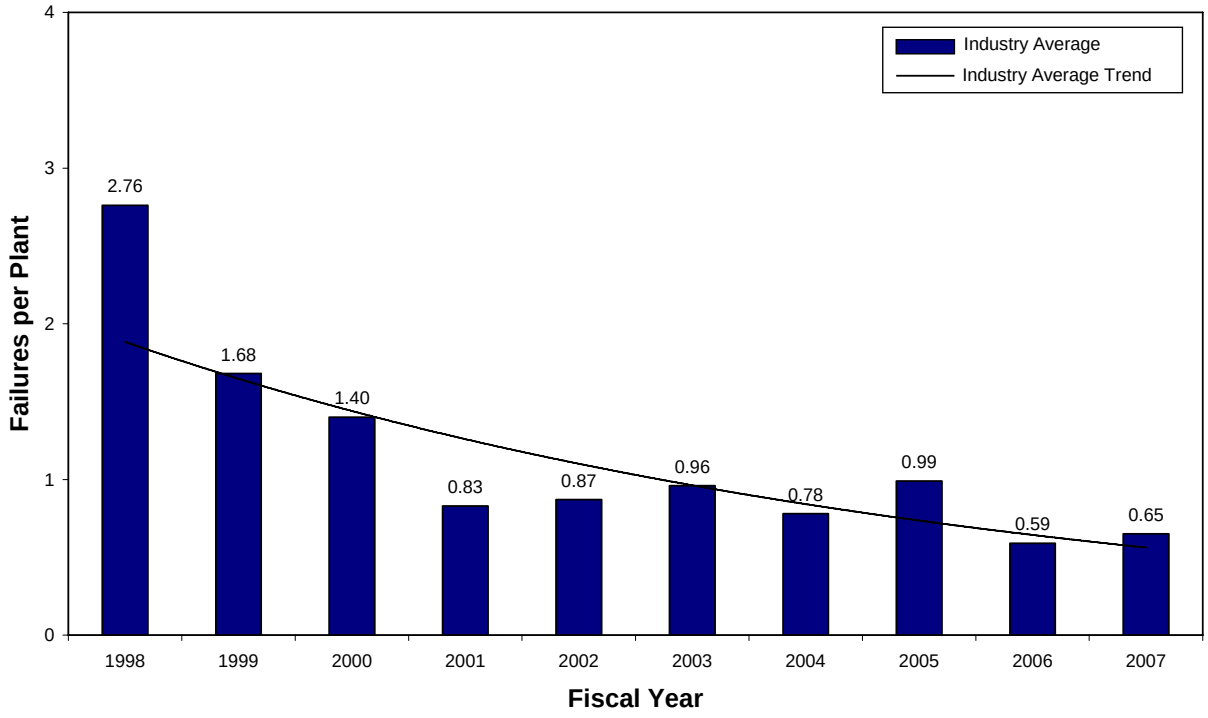
Safety System Actuations



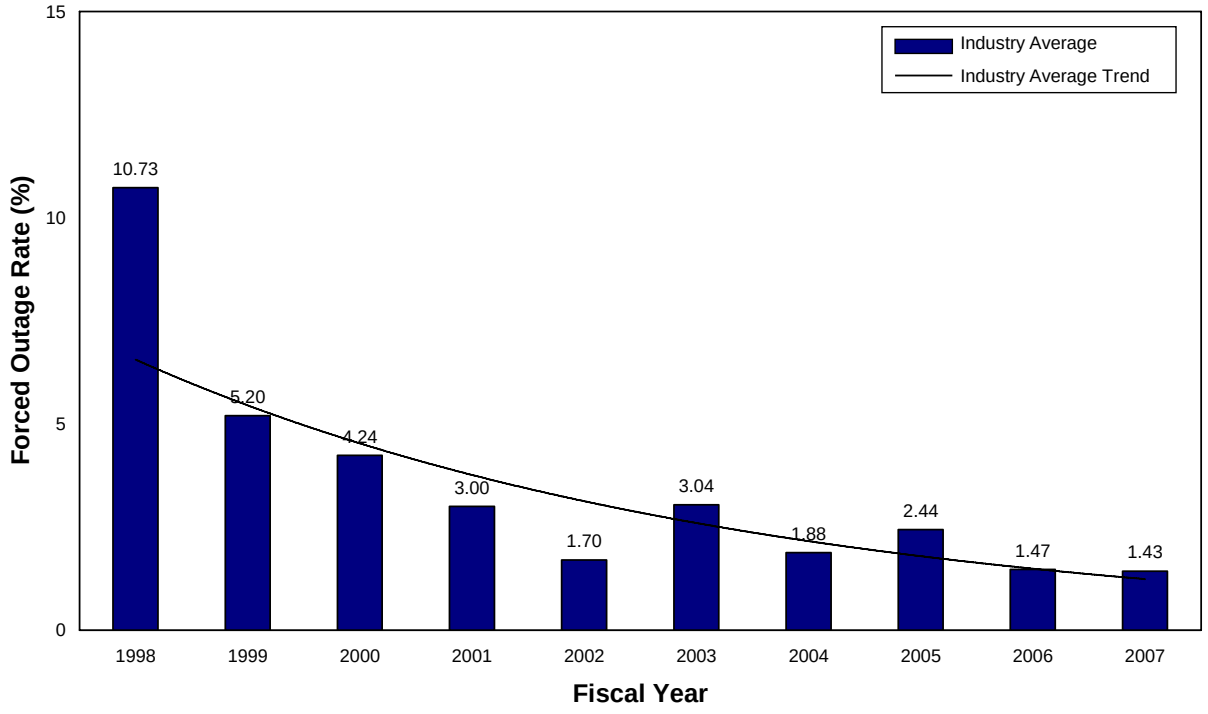
Significant Events



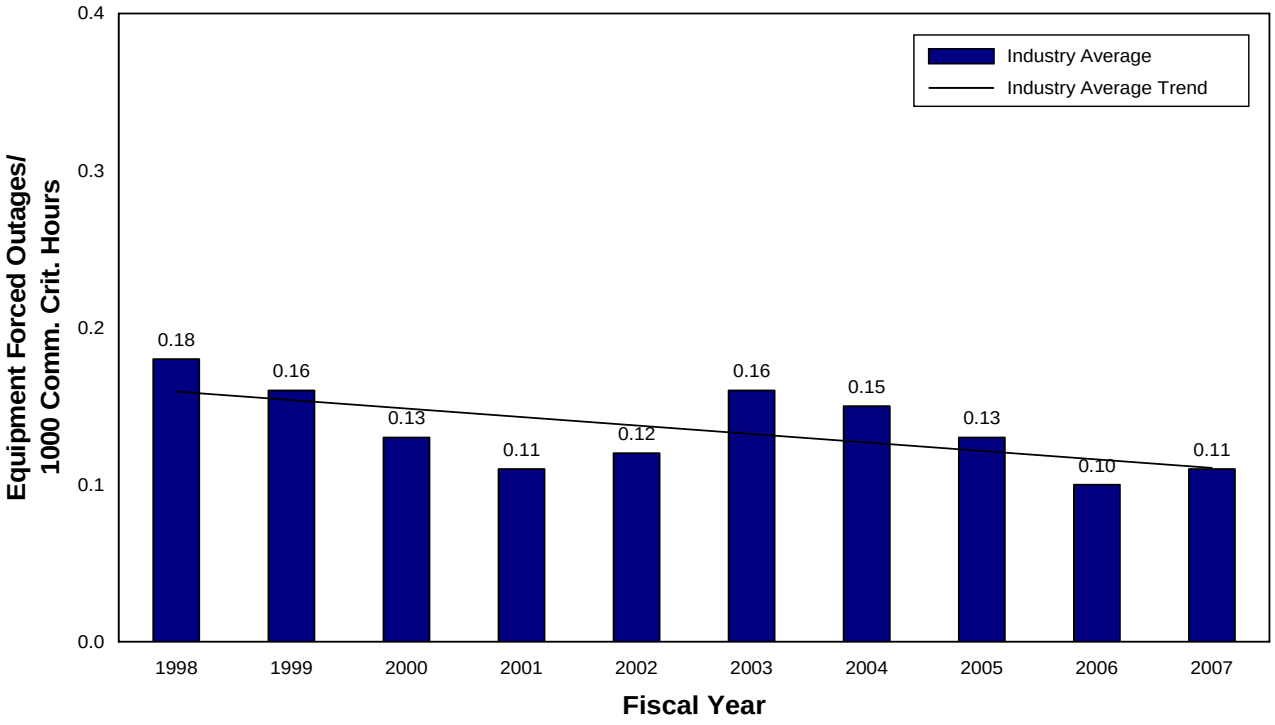
Safety System Failures



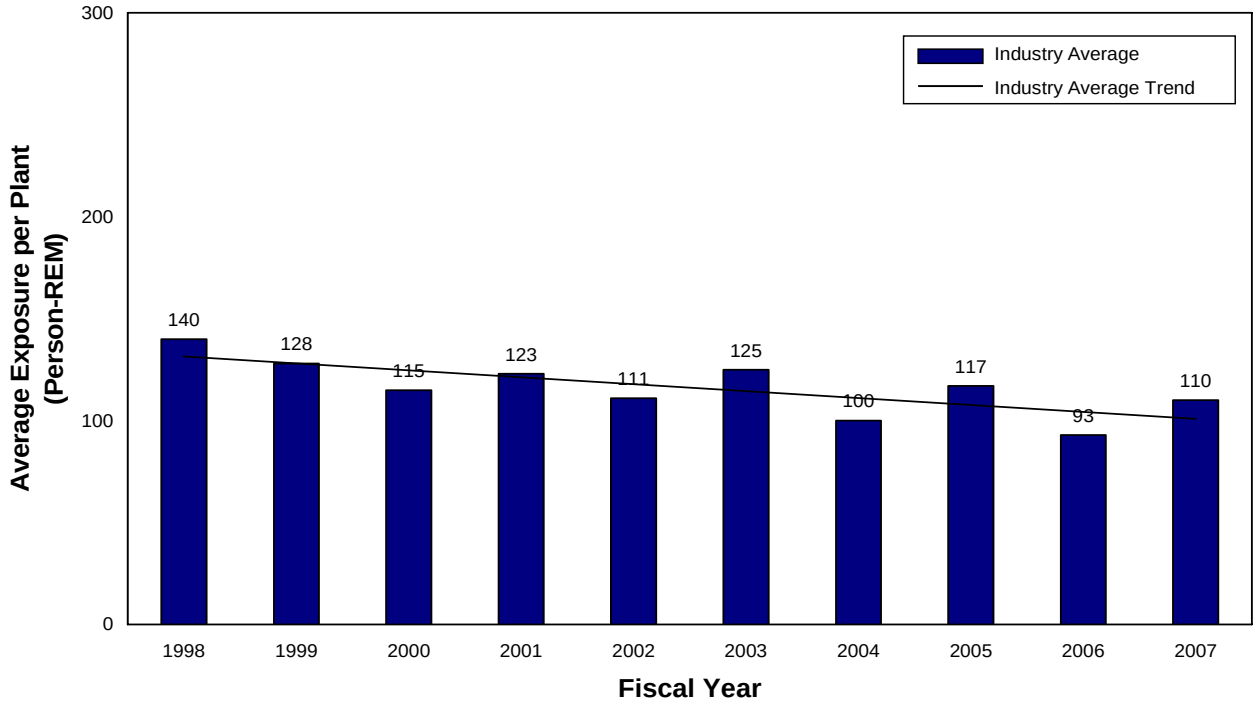
Forced Outage Rate (%)



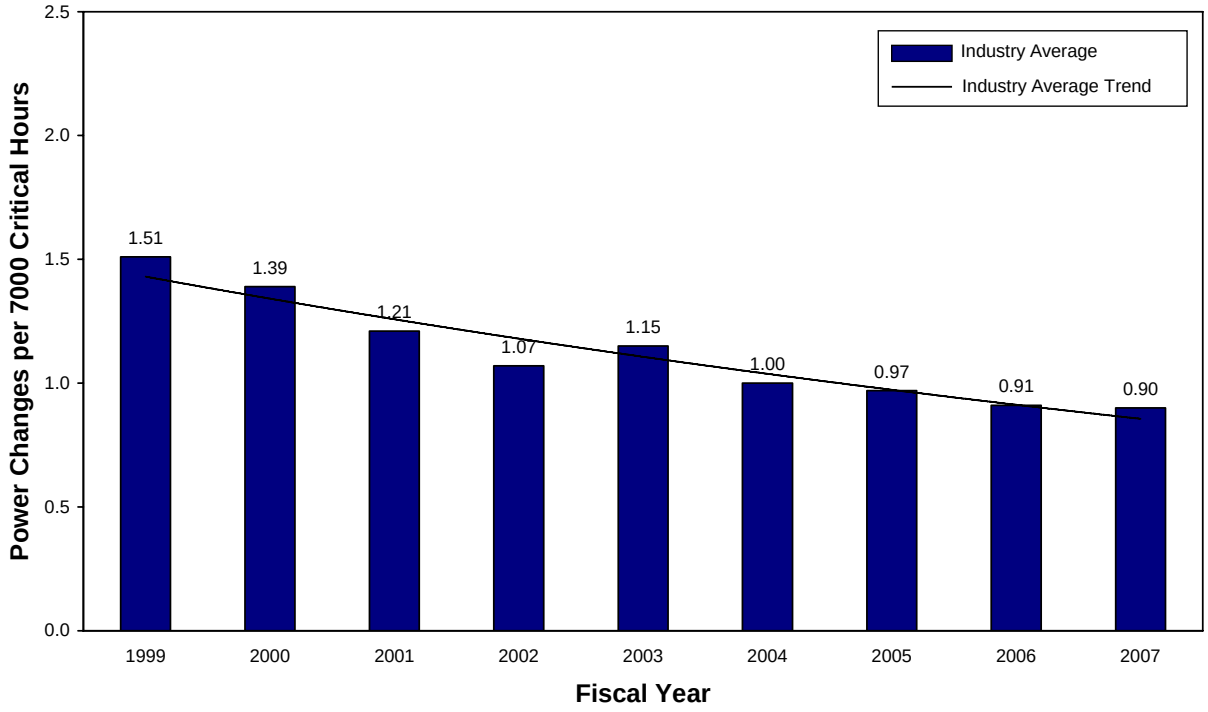
Equipment Forced Outages/1000 Commercial Critical Hours



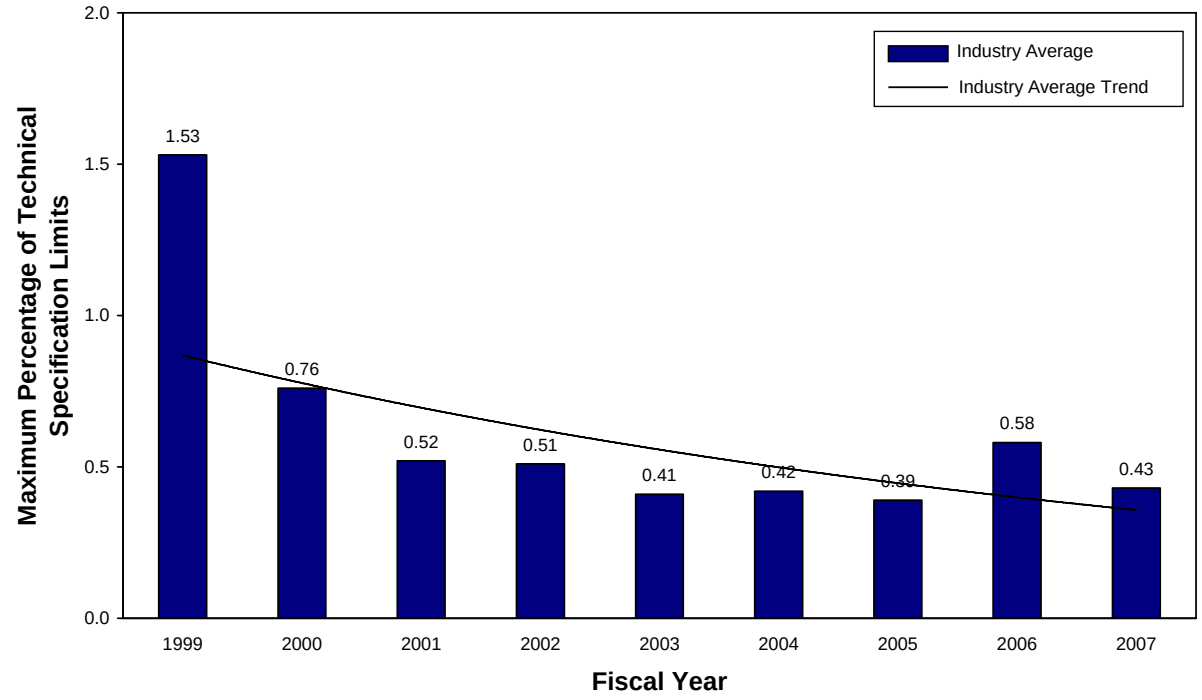
Collective Radiation Exposure



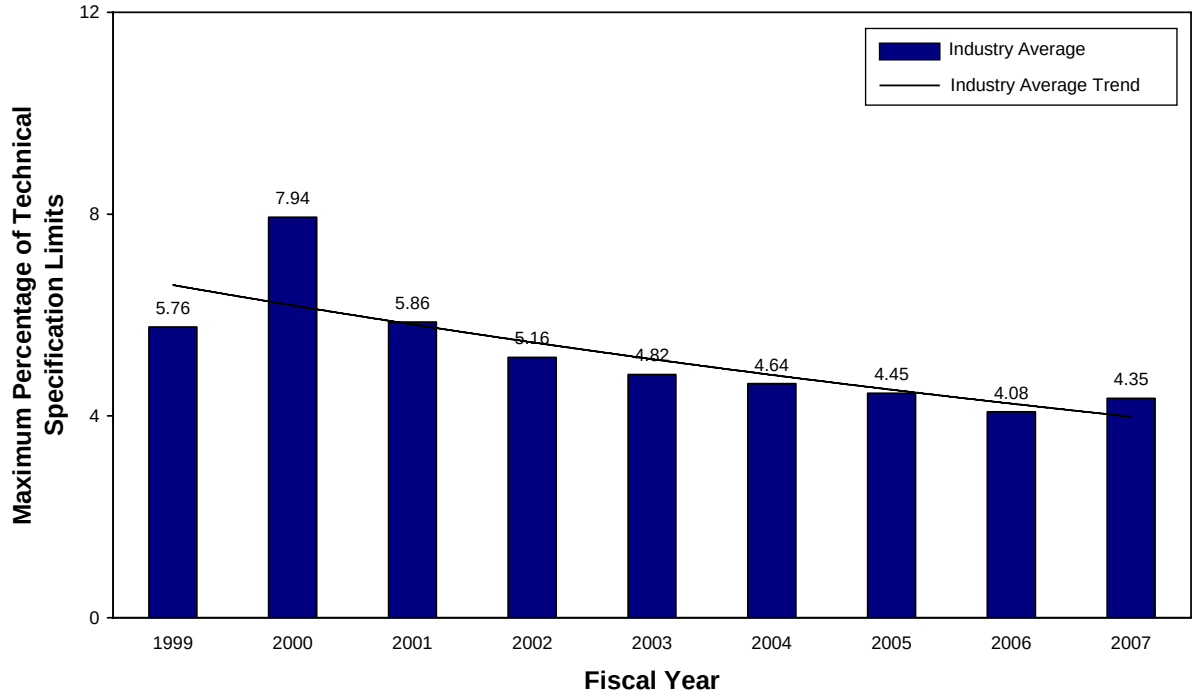
Unplanned Power Changes



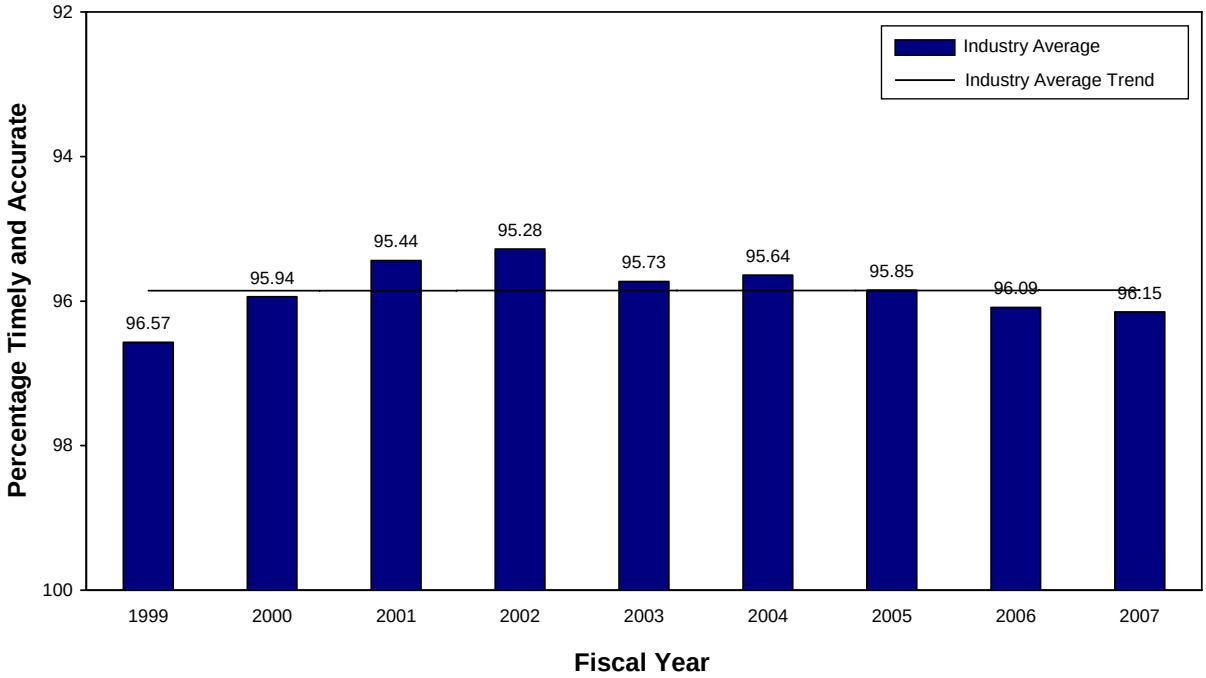
Reactor Coolant System Activity



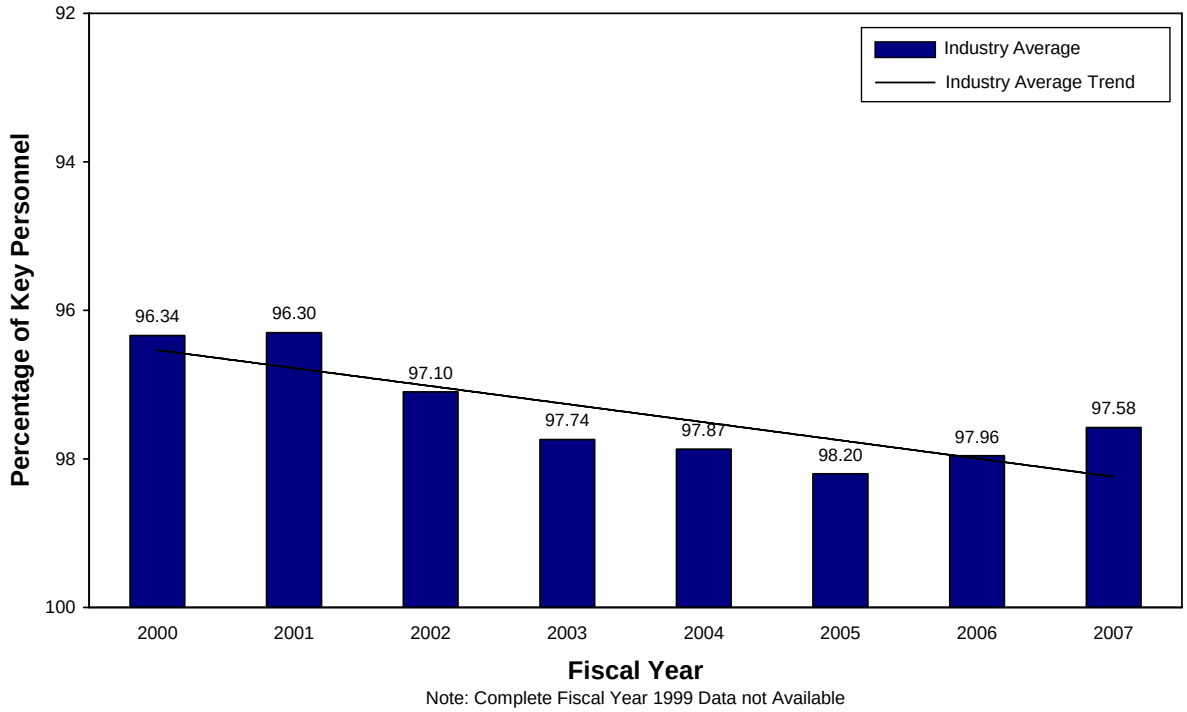
Reactor Coolant System Leakage



Drill/Exercise Performance

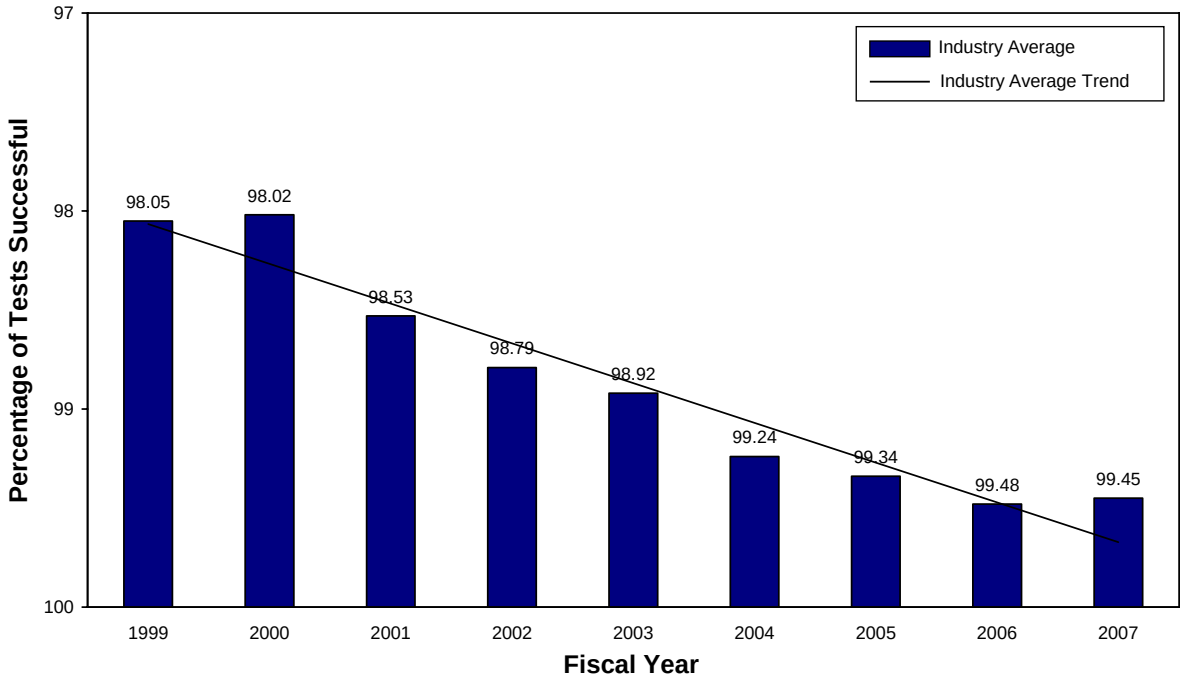


ERO Drill Participation

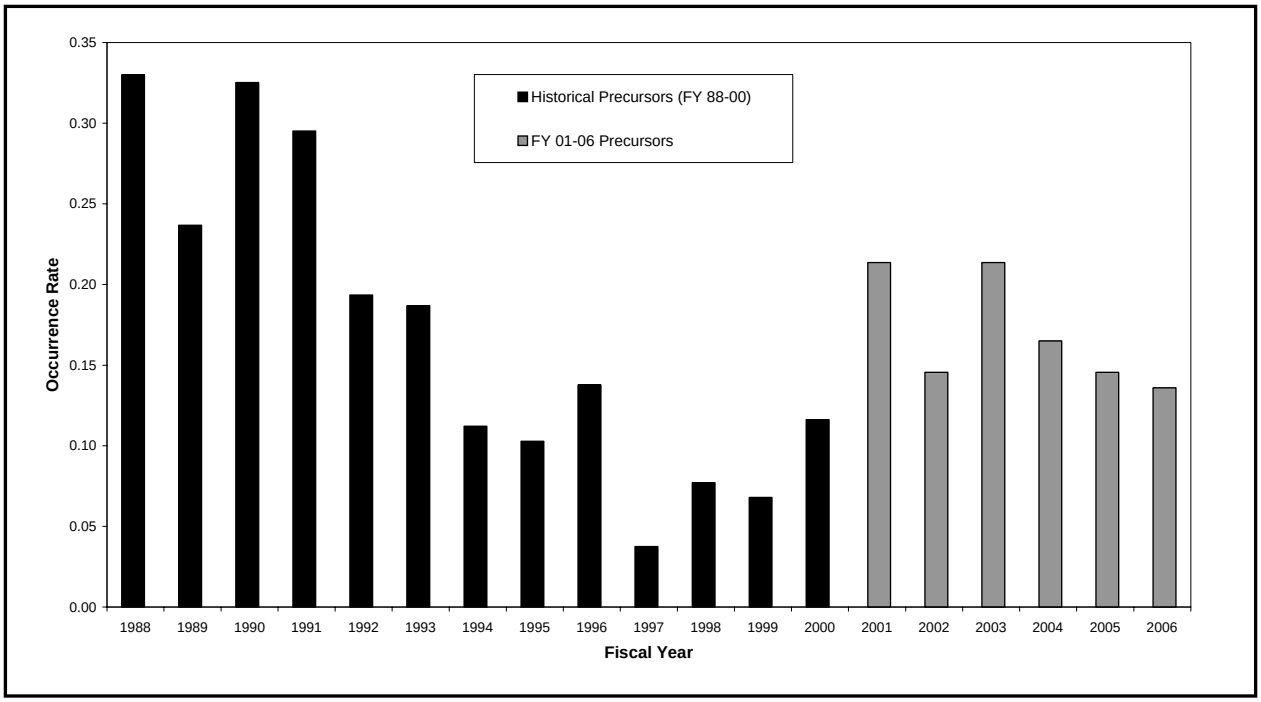


Note: Complete Fiscal Year 1999 Data not Available

Alert and Notification System Reliability



Accident Sequence Precursors



Total precursors—occurrence rate, by fiscal year. Data for FY 1988 – FY 2000 are shown for historical perspective. No trend line is shown because no statistically significant trend (p-value = 0.20) is detected for the FY 2001 – FY 2006 period.

FISCAL YEAR 2007 SHORT-TERM INDUSTRY TRENDS RESULTS

The annual industry trend analysis compares the data for the most recent year with established short-term "prediction limits." The prediction limits are 95th percentiles of predictive distributions for the data. The predictive distributions are statistical probability distributions that describe expected future performance. They are derived from performance during "baseline" periods for each performance indicator (PI). Baseline periods are periods for each PI during which the data can be regarded as fairly constant and indicative of "current" performance. There is no requirement for favorable trends to continue, and any adverse trends would need to be reversed. Therefore, for each PI, a series of trend analyses was performed to identify, if possible, a baseline period in which no statistically significant trend exists. In the Industry Trends Program (ITP) methodology, the minimum baseline period is at least 4 years, ending in the year with the most recent data (initially fiscal year (FY) 2002). If the most recent 4-year period satisfies the criteria, then the most recent 5-year period is considered. Successively longer periods are selected, as long as the statistical models fit and the test for trends shows little evidence. In the current methodology, whenever a new baseline period is sought, the period selected is the one that shows the least evidence of a trend. The results of the evaluation of the FY 2007 ITP PIs using the established prediction limits are provided below followed by plots of each PI with its FY 2007 data and associated prediction limit.

No PI exceeded its associated prediction limit in FY 2007 as shown in the following graphs.

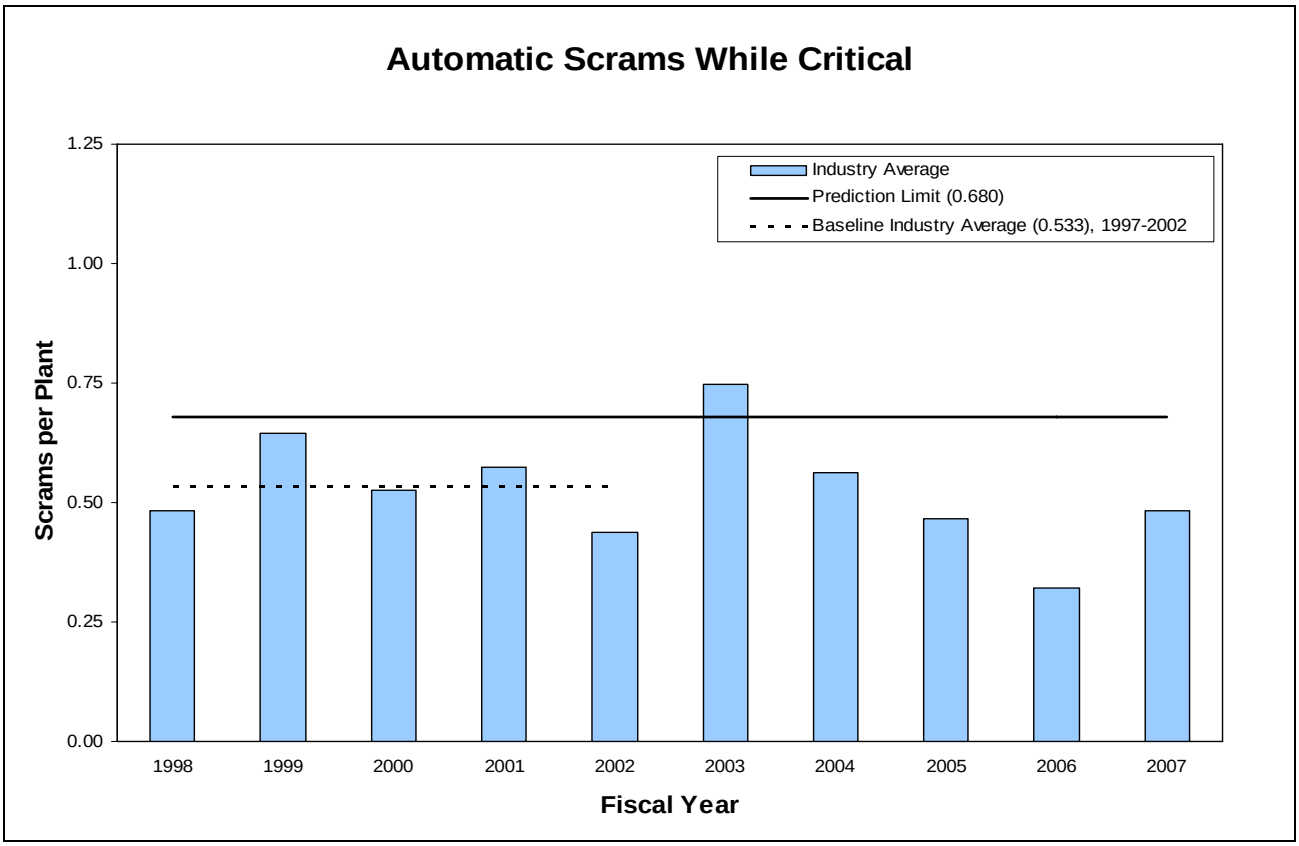


Figure 1 Automatic scrams while critical

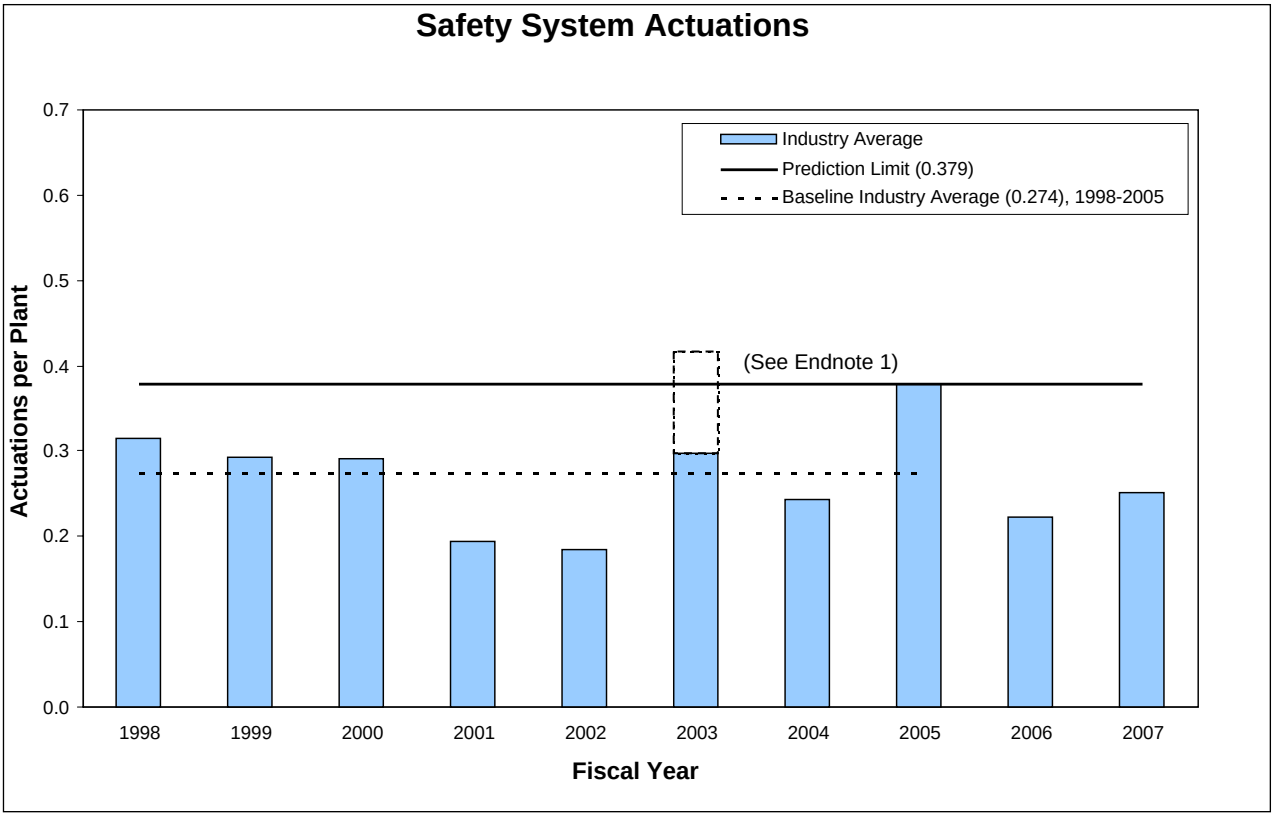


Figure 2 Safety system actuations

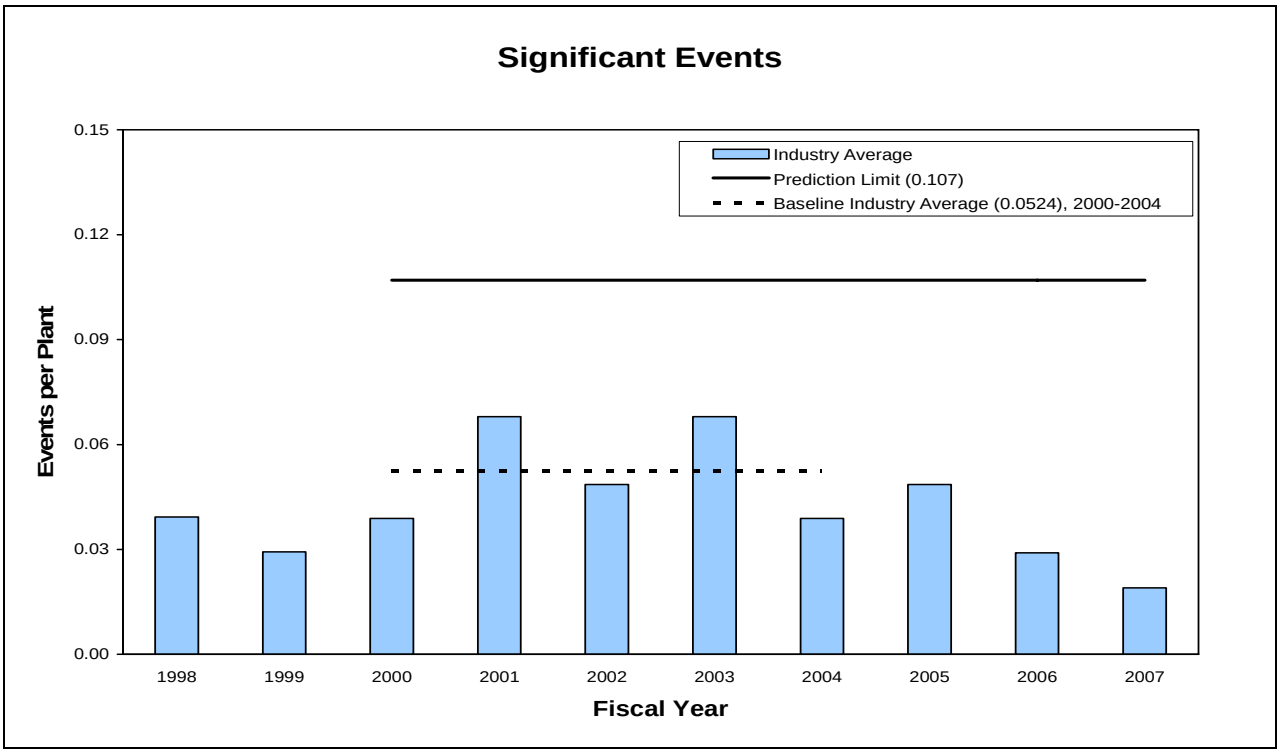


Figure 3 Significant events

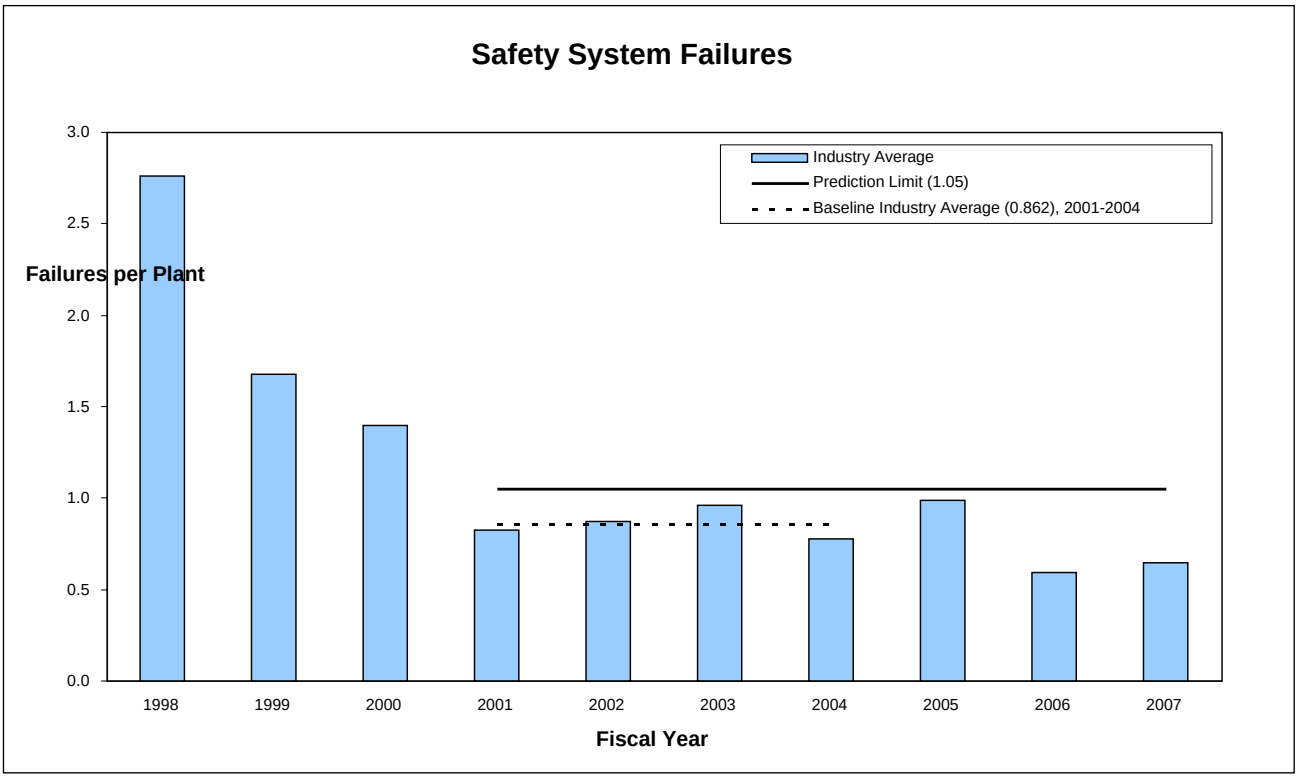


Figure 4 Safety system failures

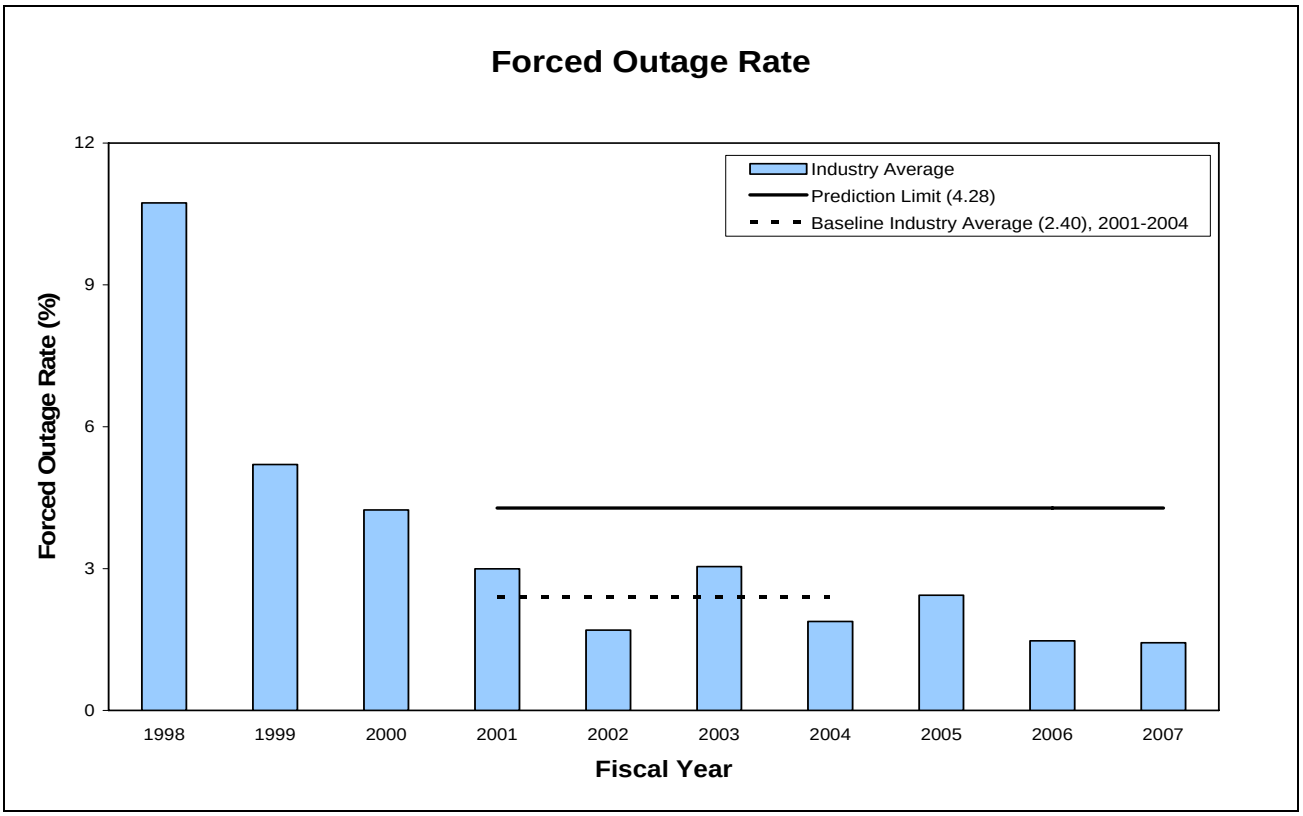


Figure 5 Forced outage rate

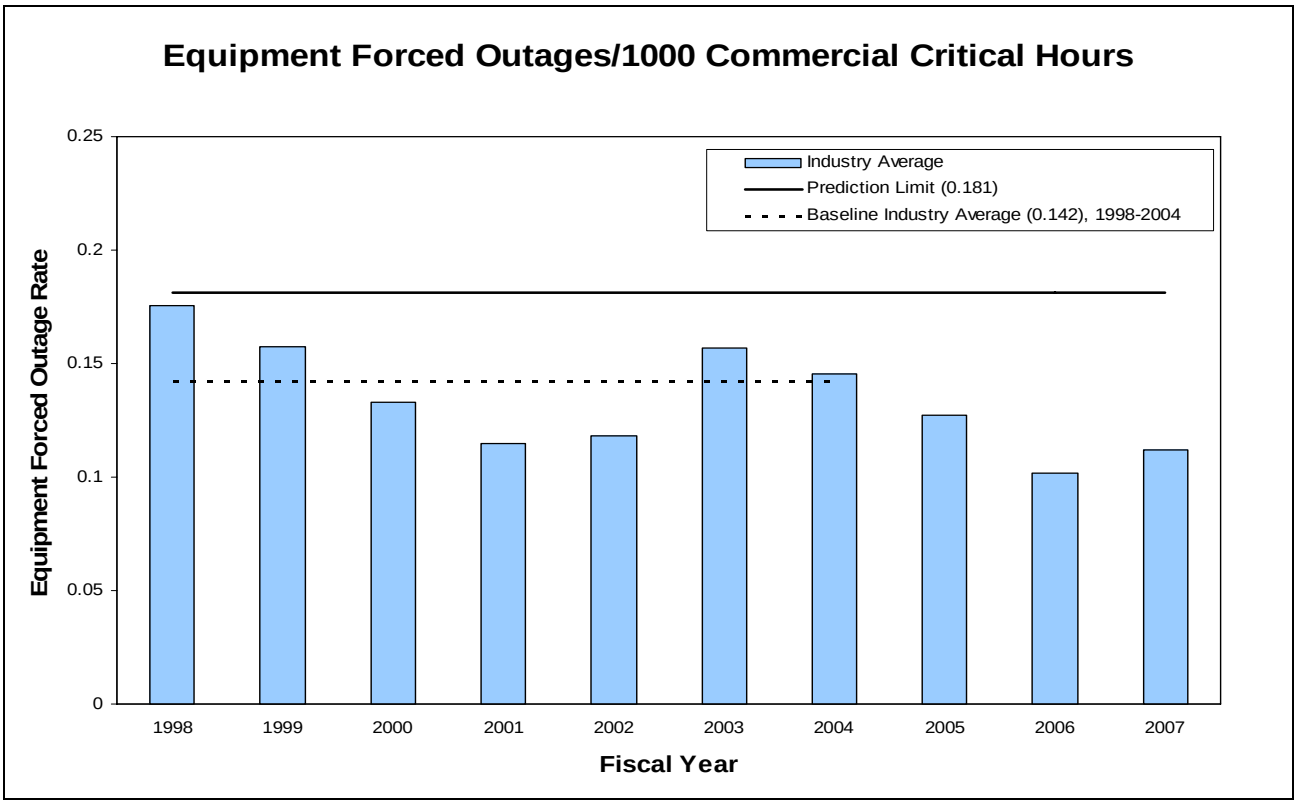


Figure 6 Equipment forced outages per 1000 commercial critical hours

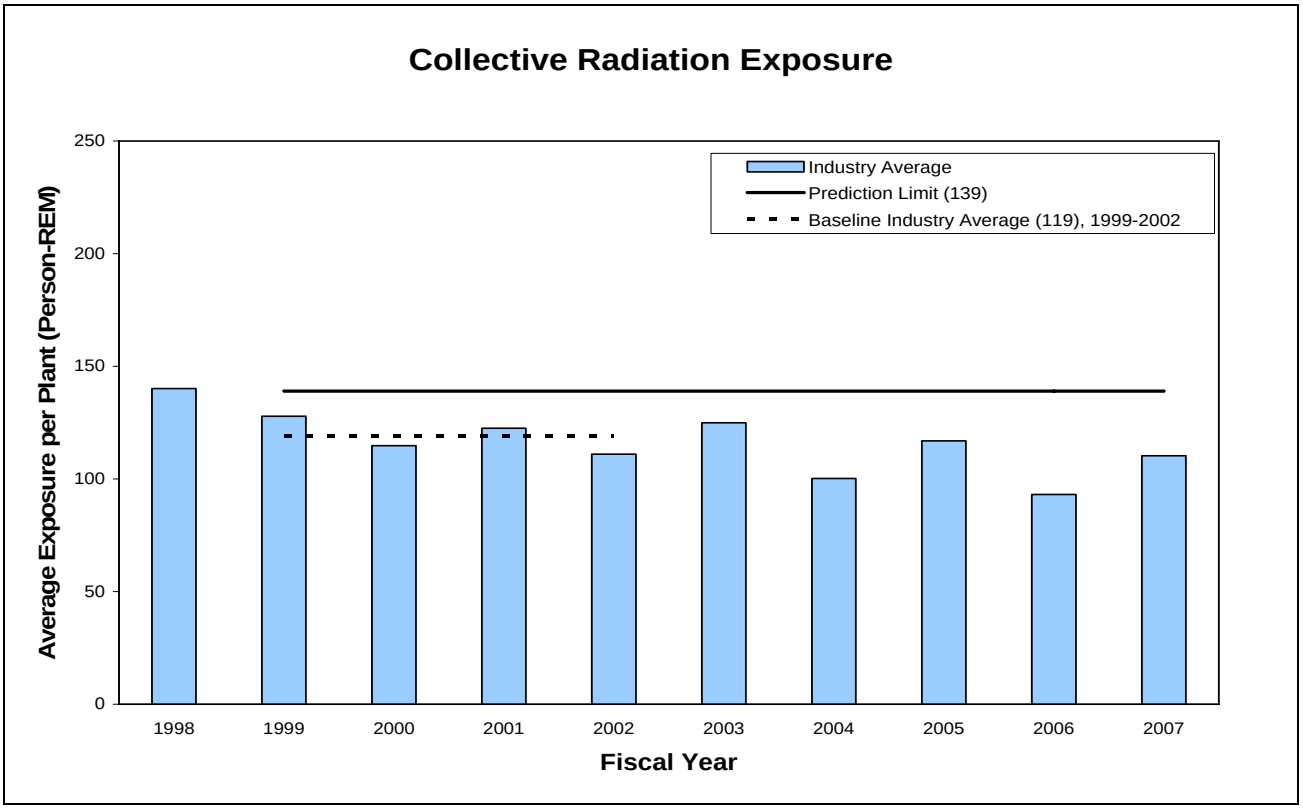


Figure 7 Collective radiation exposure

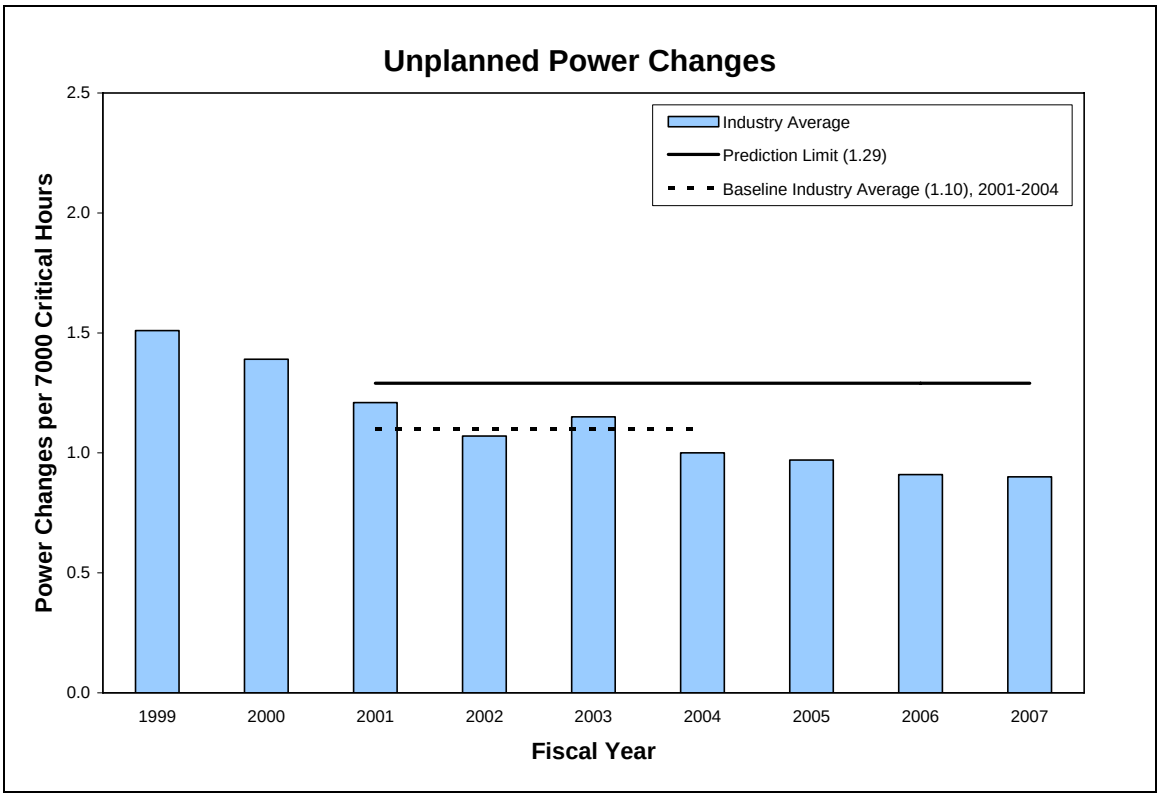


Figure 8 Unplanned power changes per 7000 critical hours

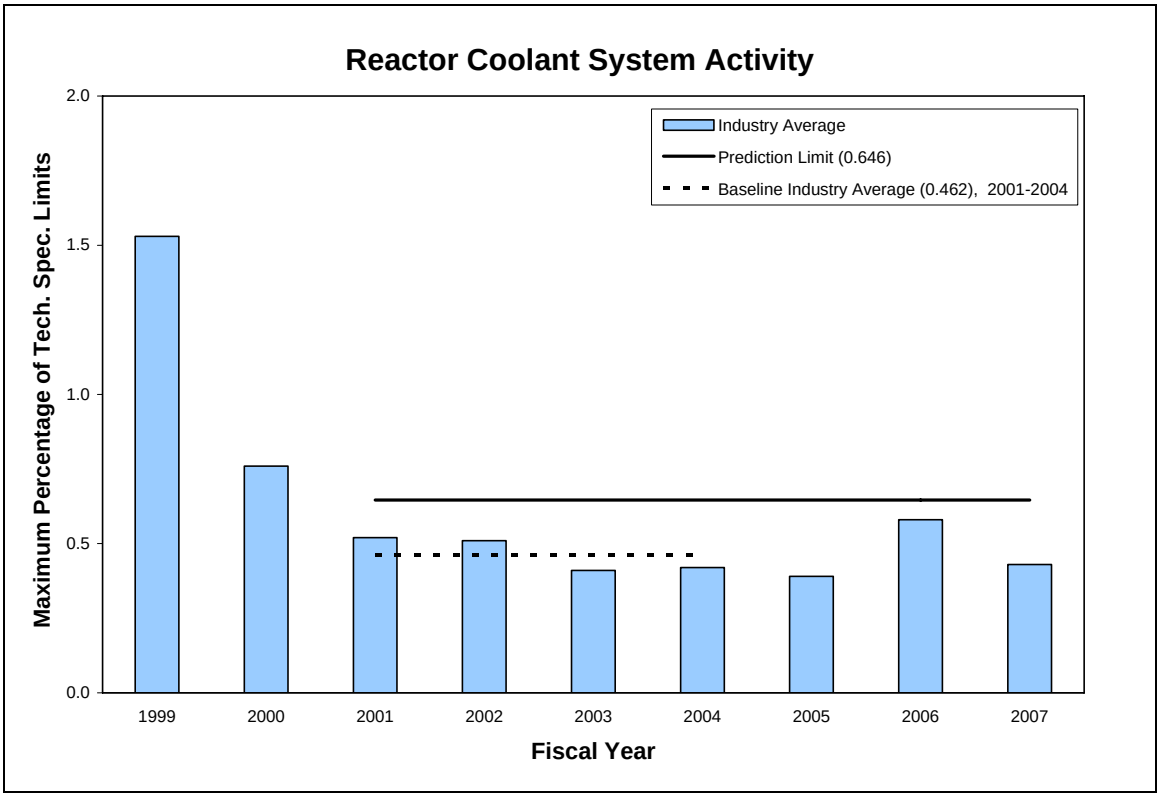


Figure 9 Reactor coolant system activity

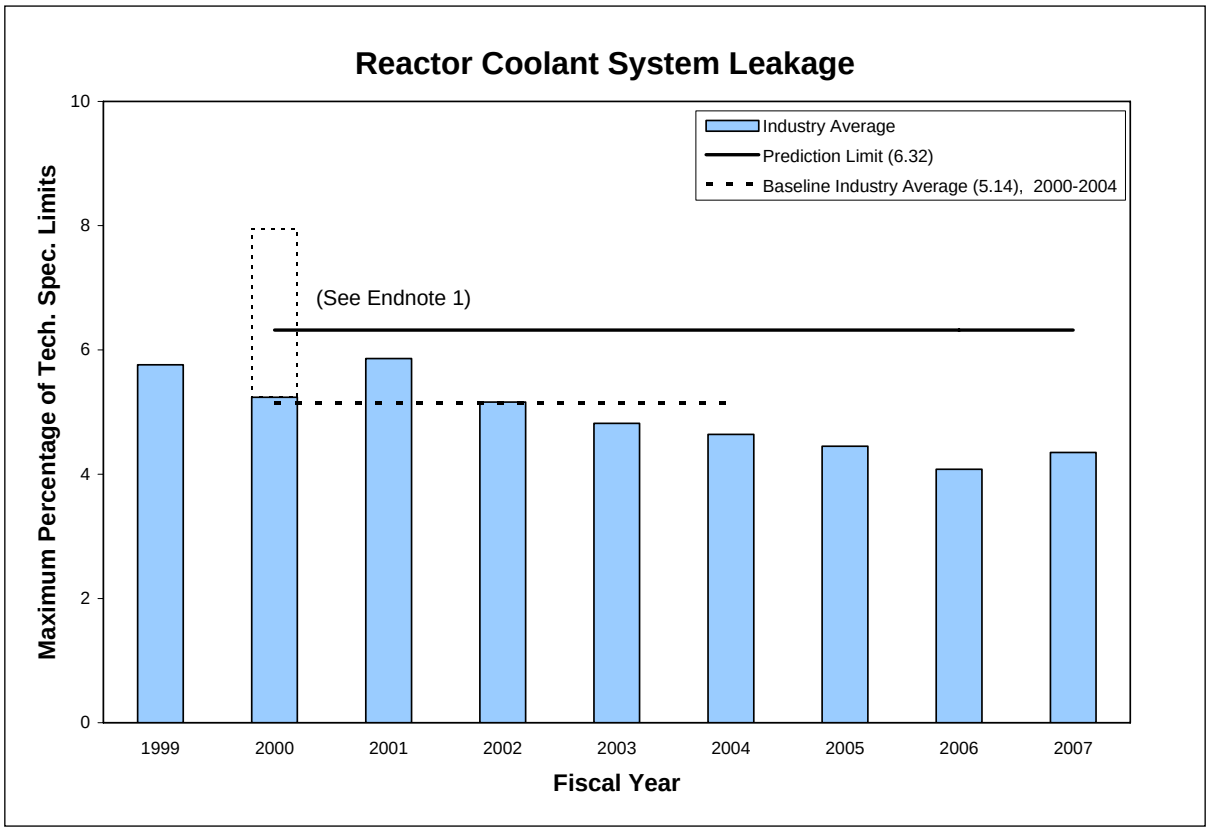


Figure 10 Reactor coolant system leakage

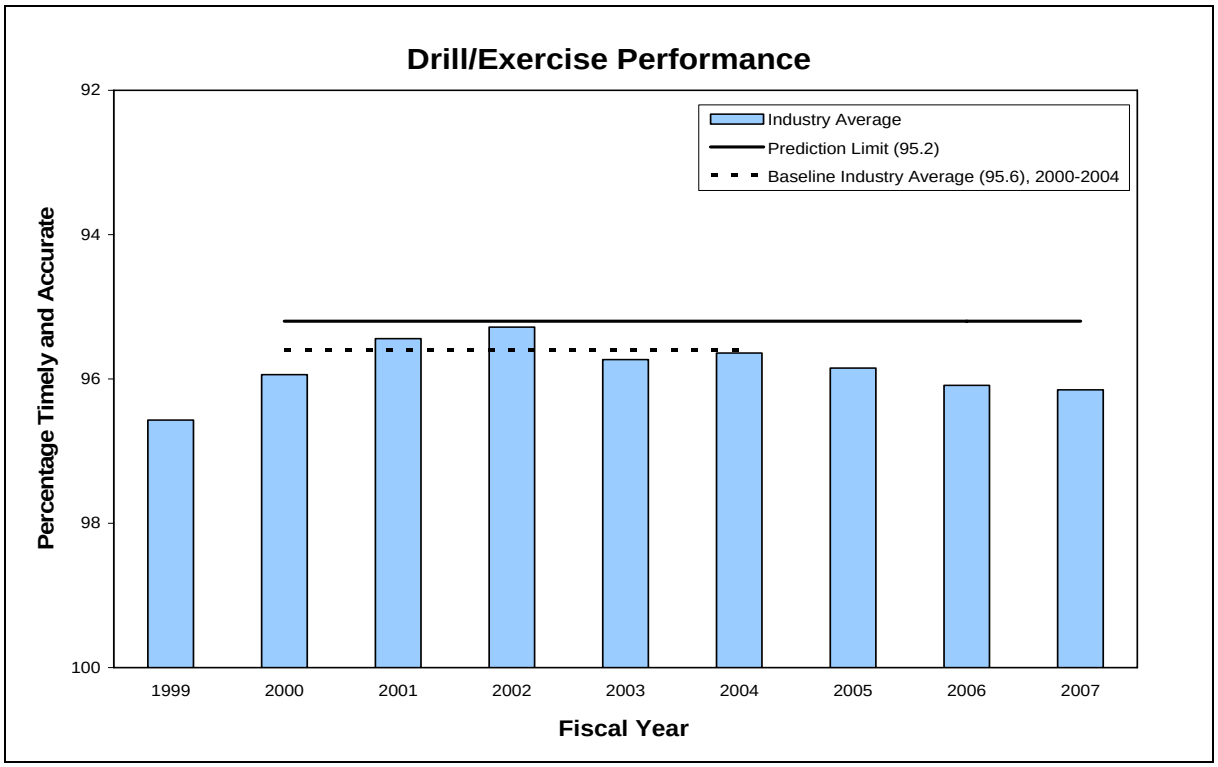


Figure 11 Drill/exercise performance

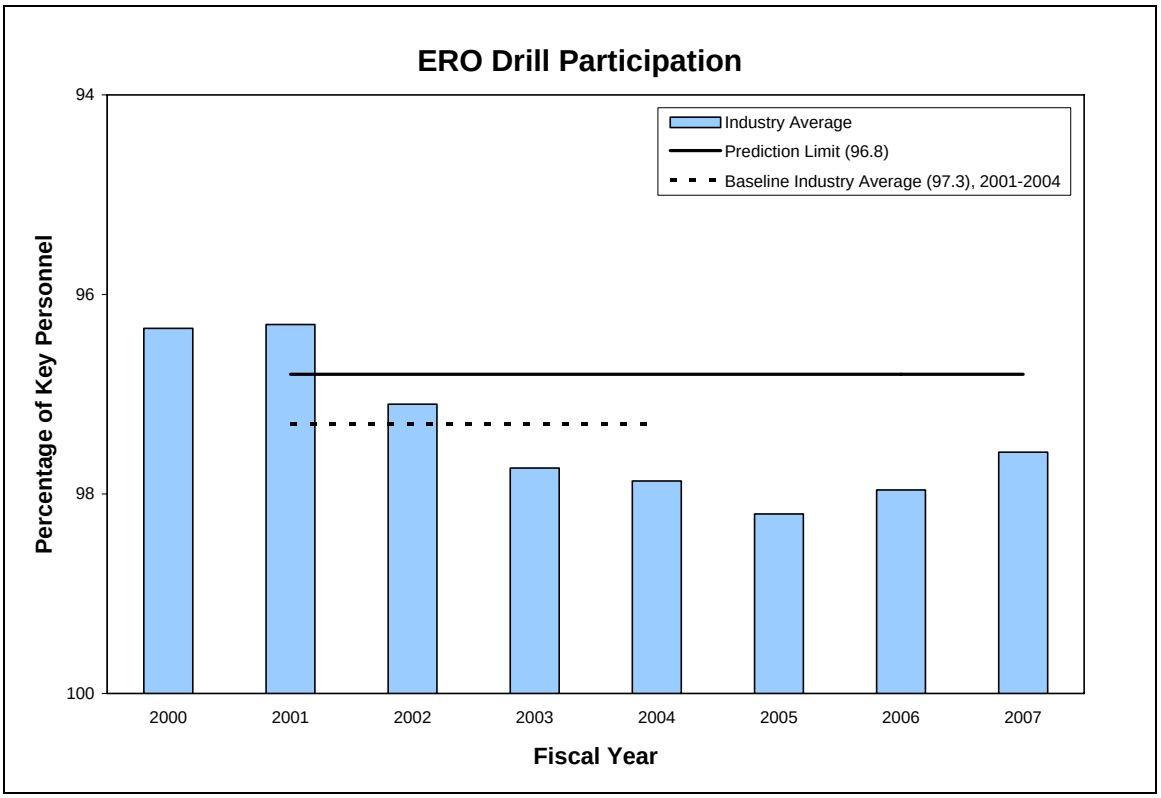


Figure 12 ERO drill participation

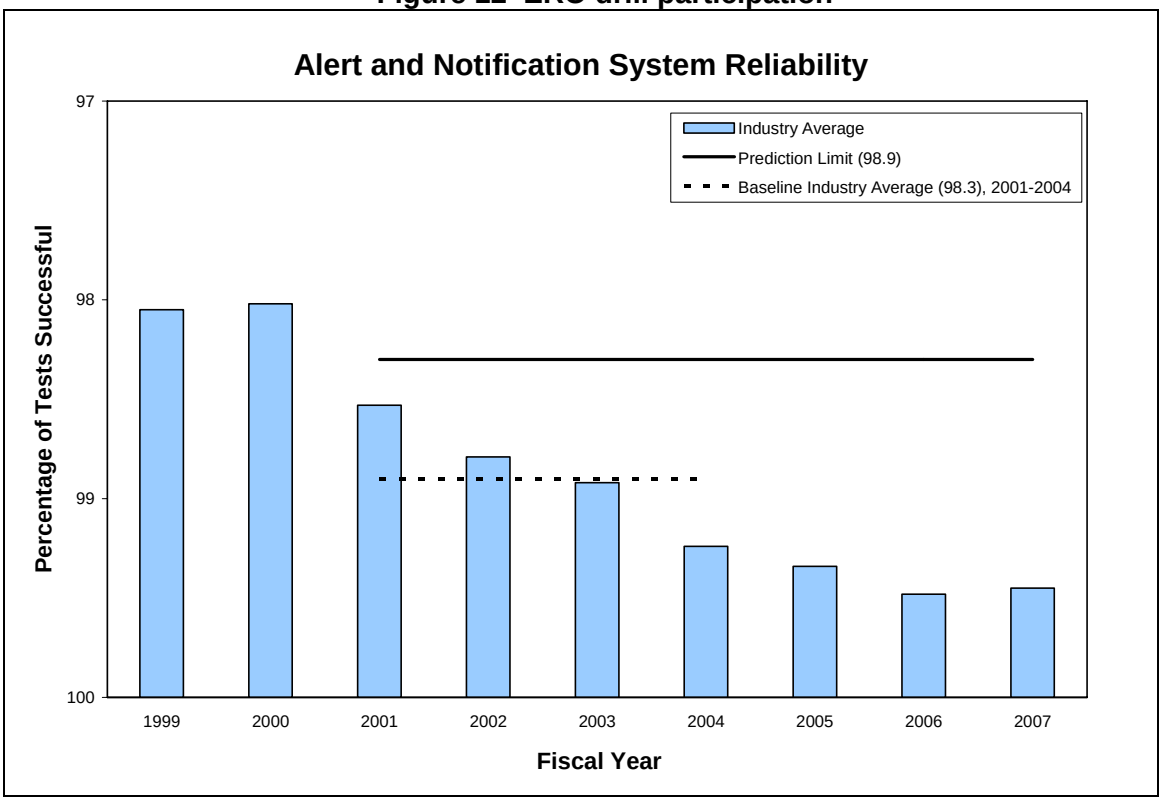


Figure 13 Alert and notification system reliability

NOTE 1: The 2003 blackout event in the safety system actuations graph (Figure 2) and the 2000 Indian Point 2 steam generator tube rupture event in the reactor coolant system leakage graph (Figure 10) were not included in the short-term data for the purpose of determining prediction limits. They were excluded from the development of the prediction limit models because they are considered outlier events that overly influenced the statistical analysis of the industrywide data. Removing these events resulted in less restrictive prediction limits.