POLICY ISSUE
(Information)

April 3, 2007 SECY-07-0063

FOR: The Commissioners

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

SUBJECT: FISCAL YEAR 2006 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 U.S. Nuclear Regulatory Commission (NRC) Industry Trends Program (ITP) for fiscal year (FY) 2006 and the status of ongoing program development.

BACKGROUND:

The NRC staff implemented the ITP in 2001. The NRC uses industry-level indicators to identify adverse trends. After assessing adverse trends for safety significance, the NRC responds as necessary to any identified safety issues, including making adjustments to the inspection and licensing programs if necessary. One important output of this program is the annual agency performance measures reported to the 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. In addition, the results of the ITP and any actions taken or planned are reviewed annually during the agency action review meeting and are reported to the Commission. This paper is the sixth annual report to the Commission on the ITP.

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

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DISCUSSION:

Using the ITP, the staff monitors trends in industry safety performance to identify and address adverse industry trends. The indicators are comprehensive and are based on the best available data. The Reactor Oversight Process provides oversight of plant-specific conditions and events.

RESULTS OF FY 2006 TREND ANALYSES

Based on the ITP indicators and the Accident Sequence Precursor (ASP) program results, the staff did not identify any statistically significant adverse trends in industry safety performance through the end of FY 2006. The graphs in Enclosure 1 show the long-term indicator trends.

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. Enclosure 2 shows the short-term trends and the prediction limits for each of the indicators. Short-term trending of the FY 2006 data did not identify any issues that warranted additional analysis or significant adjustments to the nuclear reactor safety inspection or licensing programs.

Precursor events identified by the ASP program are one indicator that the ITP uses to assess industry performance. 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 ASP program defines a *significant* precursor as an event with a CCDP or ΔCDP greater than or equal to 1×10^{-3}.

Figure 1, Total Precursors, on page 8 of Enclosure 1, depicts the occurrence rate for all precursors by FY during FY 1996 – FY 2000 and FY 2001 – FY 2005. A review of data for that period produces the following insights:

- No significant precursors (i.e., CCDP or $\Delta CDP \geq 10^{-3}$) were identified in FY 2005. The ASP program provides the basis for the FY 2005 performance plan goal measure of "zero events per year identified as a significant precursor of a nuclear accident."

- Regarding the occurrence rate of all precursors, the ASP analysis divided the data from FY 1996 through FY 2005 into two parts, FY 1996 – FY 2000 and FY 2001 – FY 2005, because the scope of the ASP program increased (e.g., inclusion of external events and significance determination process findings) in FY 2000. These increases in scope have resulted in the reporting of a higher number of lower-risk precursors (i.e., CCDP or $\Delta CDP < 10^{-4}$). The analysis identified no other trends for either of these 5-year periods. The mean rate of occurrence of all precursors from FY 2001 – FY 2005 is higher than that observed during FY 1996 – FY 2000. In addition to the increases in ASP program scope, the increased number of outlier events (e.g., the 11 grid-related loss-of-offsite-power events in FY 2003 and FY 2004 as well as the 11 control rod drive mechanism housing cracking events between FY 2001 and FY 2003) accounts for the observed change. During the more recent time period from FY 2001 – FY 2005, the analysis detected a statistically significant decreasing trend for higher-risk precursors (i.e., CCDP or $\Delta CDP \geq 10^{-4}$).

The ITP uses the ASP results as one of the agency's monitored indicators. The NRC Performance and Accountability Report for FY 2006 and the NRC Performance Budget for FY 2007 will report these results.

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 significant adverse trends.

As a first step in enhancing the ITP to address the weaknesses listed above, the initiating event cornerstone of safety was chosen 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 2006 the staff continued to develop (1) an index for boiling-water reactors that monitors 9 risk-significant initiating events and (2) a similar index for pressurized-water reactors that monitors 10 events (the additional event category is steam generator tube rupture). The index weights each initiating event according to its relative contribution to industry core damage frequency. This indicator is the Baseline Risk Index for Initiating Events (BRIIE).

As discussed 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," an expert panel was formed with the objective of reviewing the BRIIE and establishing a threshold value for reporting to Congress. The panel reached the following conclusions:

- Maintain a two-level process for BRIIE. The first level provides short-term trending information and an action point for NRC engagement. The second level provides a risk perspective of industry performance as a deviation from a baseline value and the proximity of the deviation from a set threshold.

- The presentation for BRIIE should be in a bar graph that provides three separate values for each year; one bar providing industry wide results, one bar for Boiling Water Reactor results, and the third bar for Pressurized Water Reactors.

- The BRIIE should be reported as a change in Core Damage Frequency (ΔCDF) with Bayesian updating.

- The threshold for reporting to Congress should be set at 1×10^{-5} per reactor critical year. It should only be associated with the ΔCDF BRIIE calculations.

NUREG/CR-6932 (INLEXT-06-11950), "Baseline Risk Index for Initiating Events (BRIIE)," which will be submitted for publication in May 2007, will provide historical results and the technical basis for BRIIE. The staff has incorporated BRIIE into the ITP. Data collection started on January 1, 2007, and the BRIIE results as an ITP indicator will be reported in the Commission paper on the FY 2007 ITP results (to be issued in early 2008).

COMMITMENTS:

The staff will incorporate the BRIIE concept into NRC Inspection Manual Chapter (IMC) 0313 and will formally use BRIIE results as an ITP indicator in the FY 2007 Commission paper (to be issued in early 2008). In SECY-06-0076, the staff also committed to revise IMC 0313 to include a process to ensure revised and updated significant events data are included in the count of Significant Events. The staff decided to postpone this change to IMC 0313 in order to include BRIIE at the same time. Both the new process and the BRIIE concept will be included in the next revision to IMC 0313.

RESOURCES:

In FY 2007 approximately 0.8 full-time equivalent (FTE) and $425,000 is needed and, in FY 2008, 0.7 FTE and $425,000 is needed for ongoing ITP implementation. The resources are currently in the budget. For FY 2009, approximately 0.7 FTE, and $475,000 for contractor support is needed and will be addressed through the FY 2009 Planning, Budgeting, and Performance Management (PBPM) process. Office of Nuclear Regulatory Research (RES) support to the Industry Trends Program involves operating experience data and models developed and budgeted under other RES programs, such as ASP. RES also directly supports the ITP through the continued improvement of BRIIE. For FY 2007, RES has budgeted approximately $50,000 and 0.1 FTE. RES work in support of BRIIE will be completed at the end of FY 2007. The resources budgeted in the Office of Nuclear Reactor Regulation (NRR) and RES are adequate for ongoing ITP implementation.

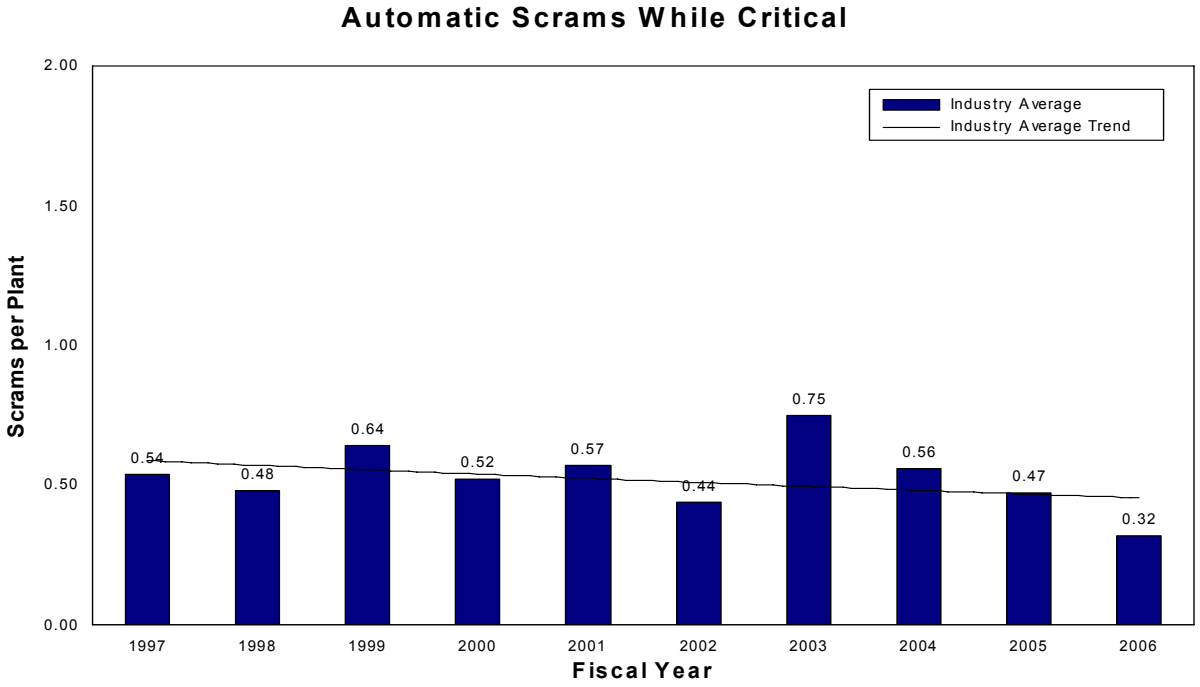
COORDINATION:

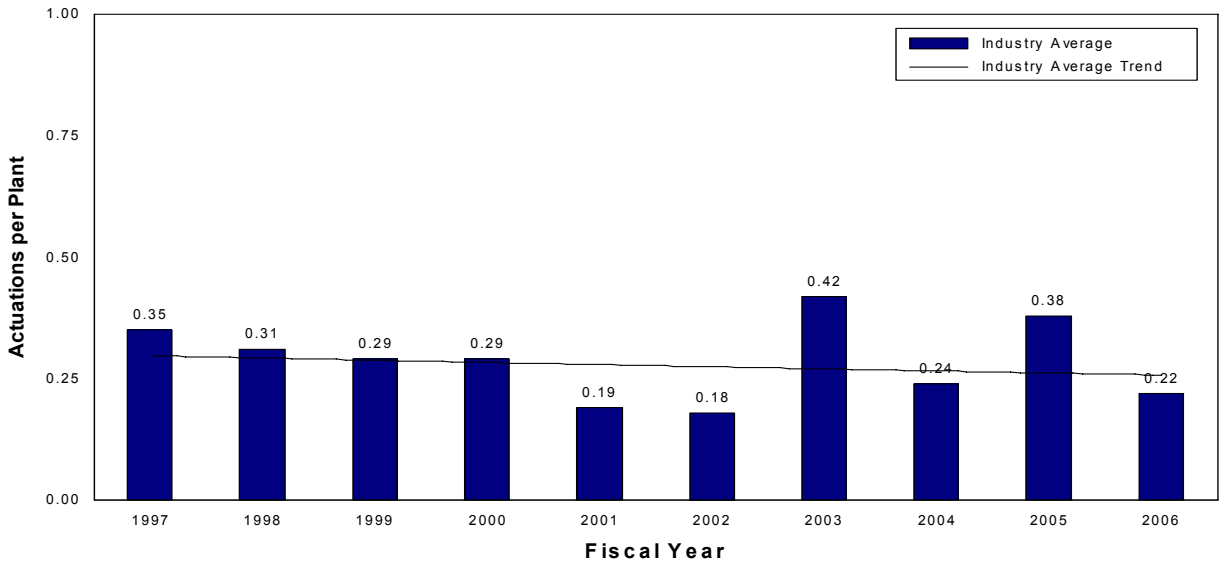
The Office of the Chief Financial Officer has reviewed this paper and concurs. The Office of the General Counsel has reviewed this paper and has no legal objection.

/RA Martin J. Virgilio, Acting for/
Luis A. Reyes
Executive Director
for Operations

Enclosures:
1. FY 2006 Long-Term Industry Trends Results
2. FY 2006 Short-Term Industry Trends Results

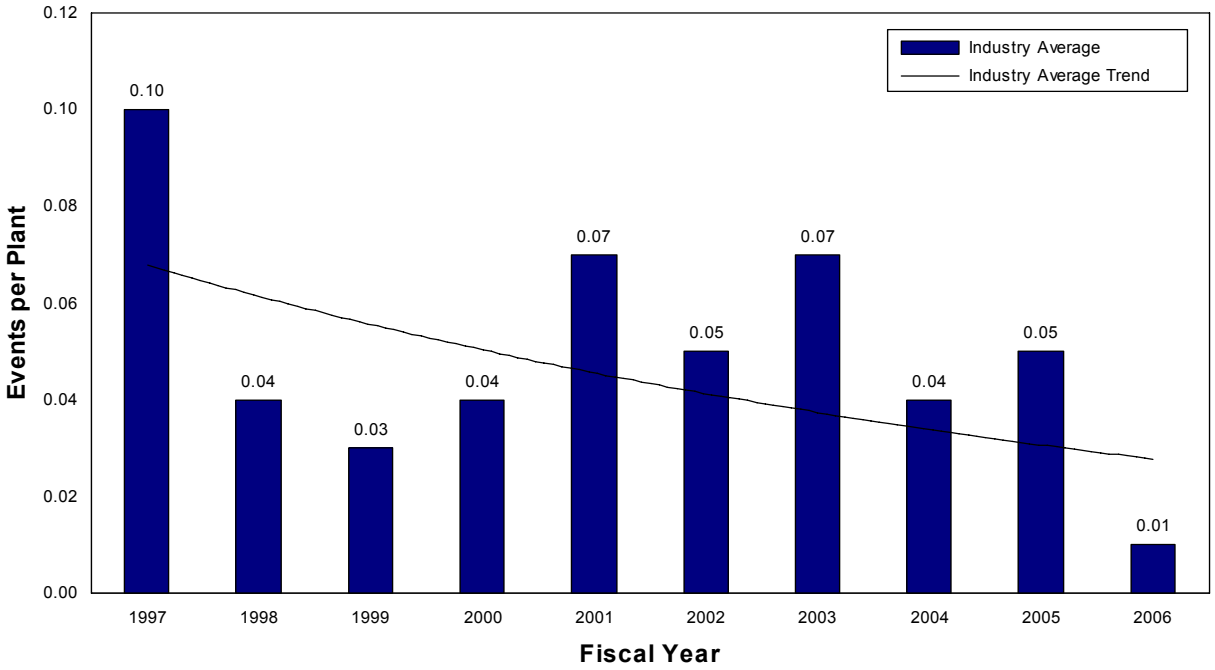
FY 2006 Long-Term Industry Trends Results



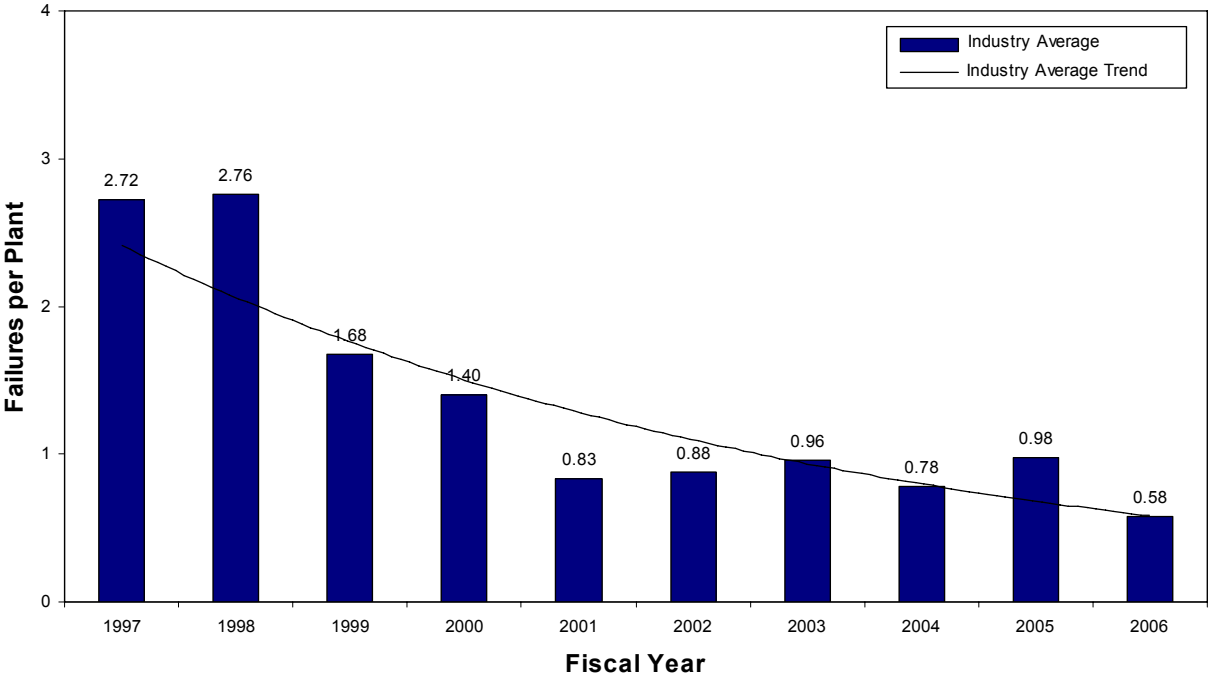


Enclosure 1

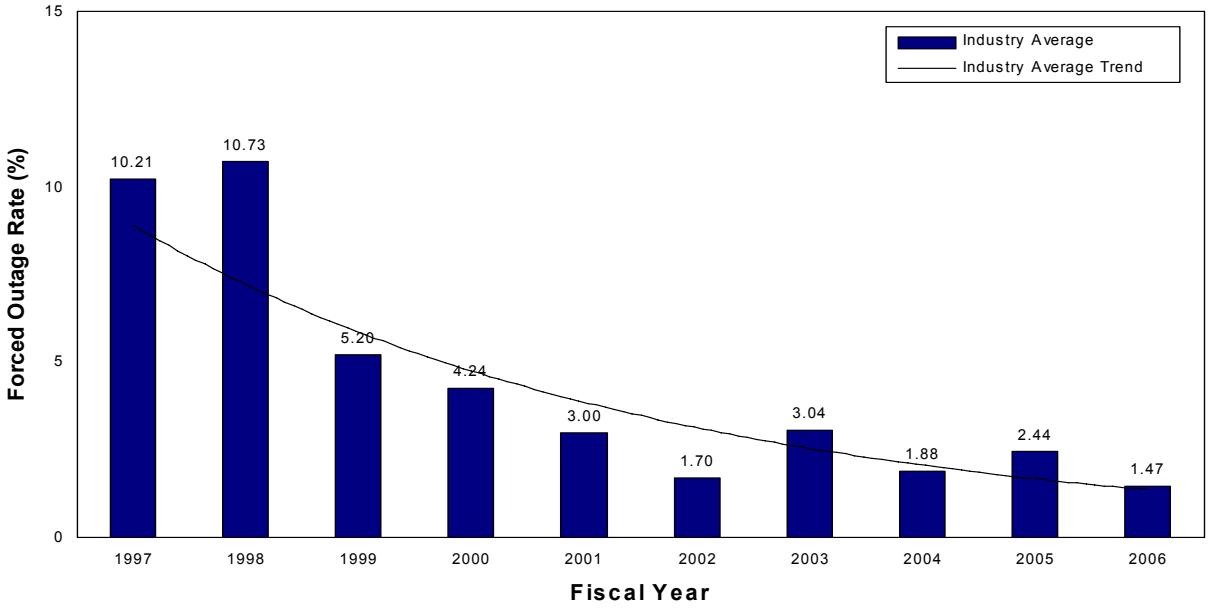
Significant Events



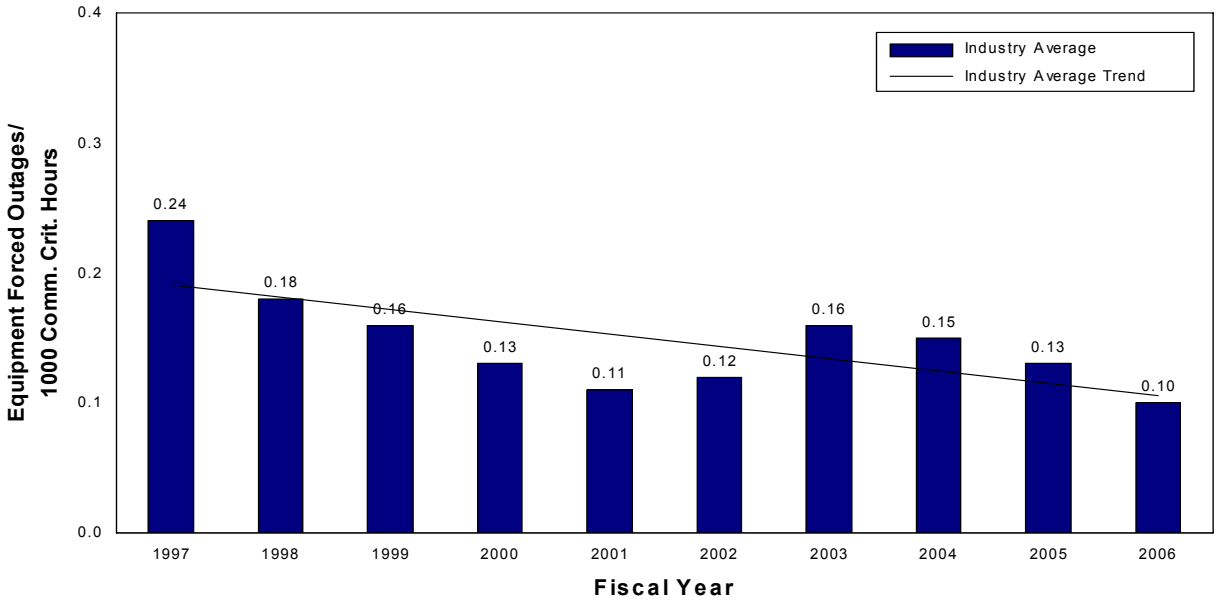
Safety System Failures



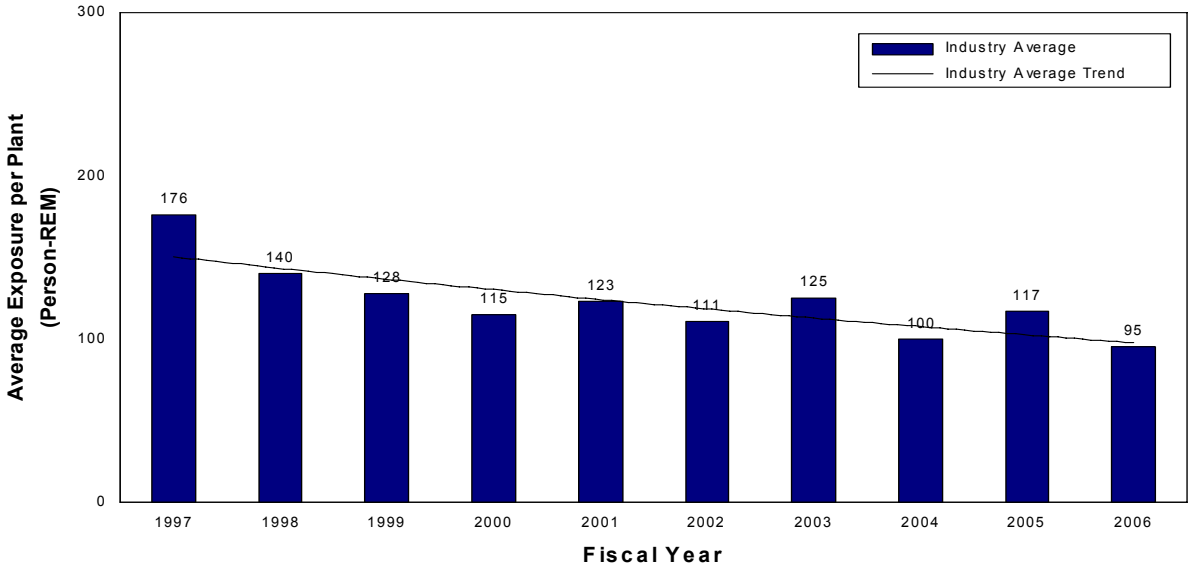
Forced Outage Rate (%)



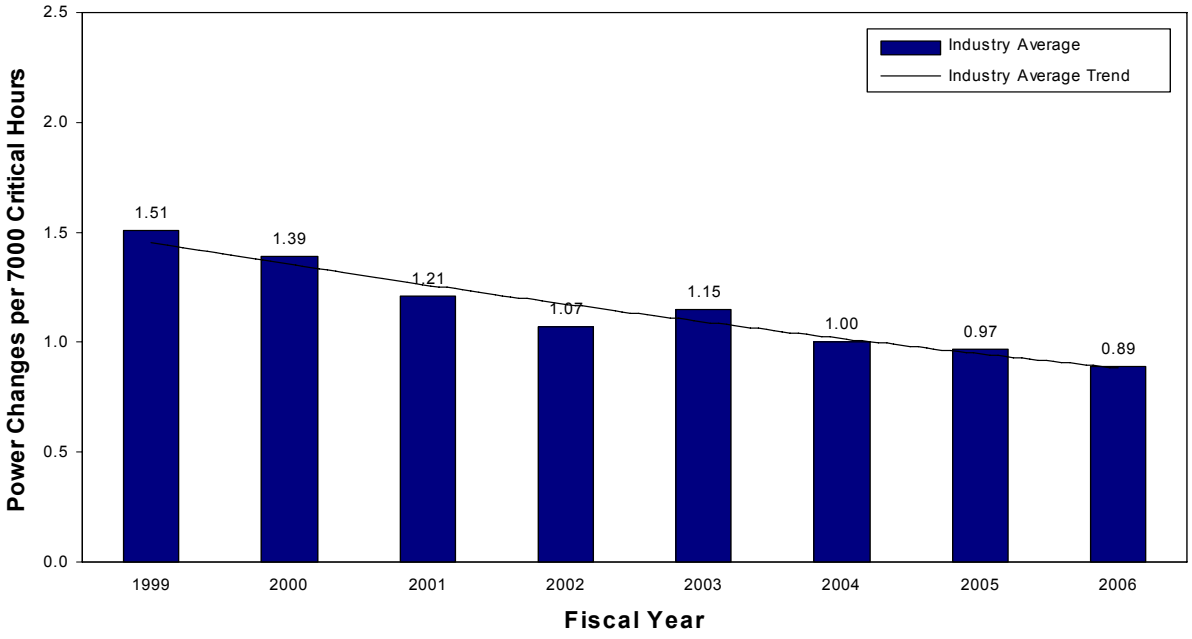
Equipment Forced Outages/1000 Commercial Critical Hours



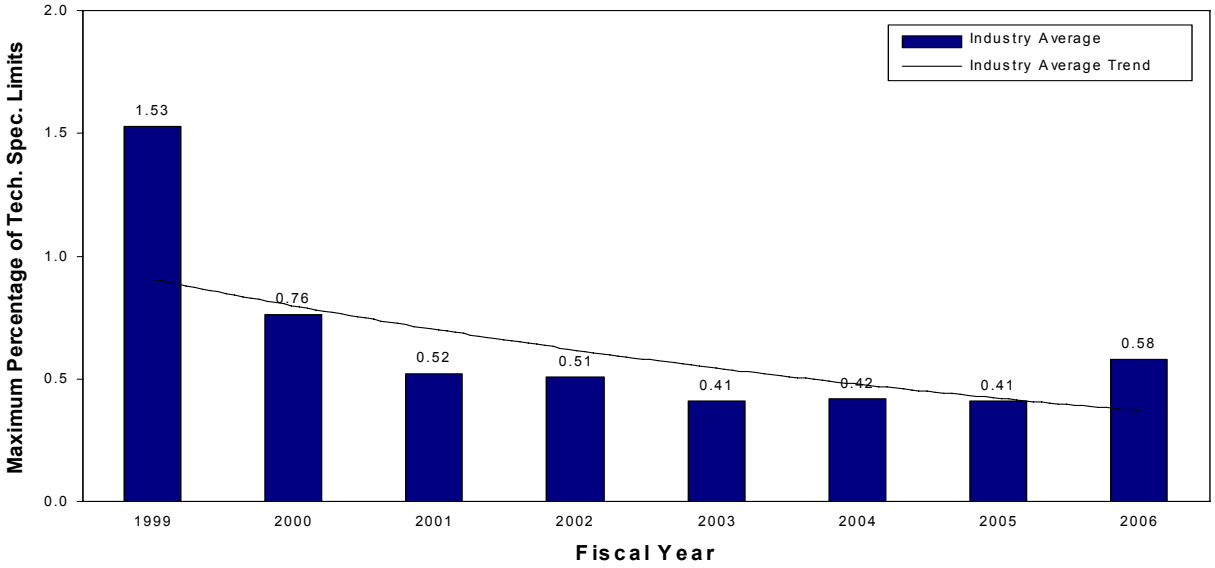
Collective Radiation Exposure



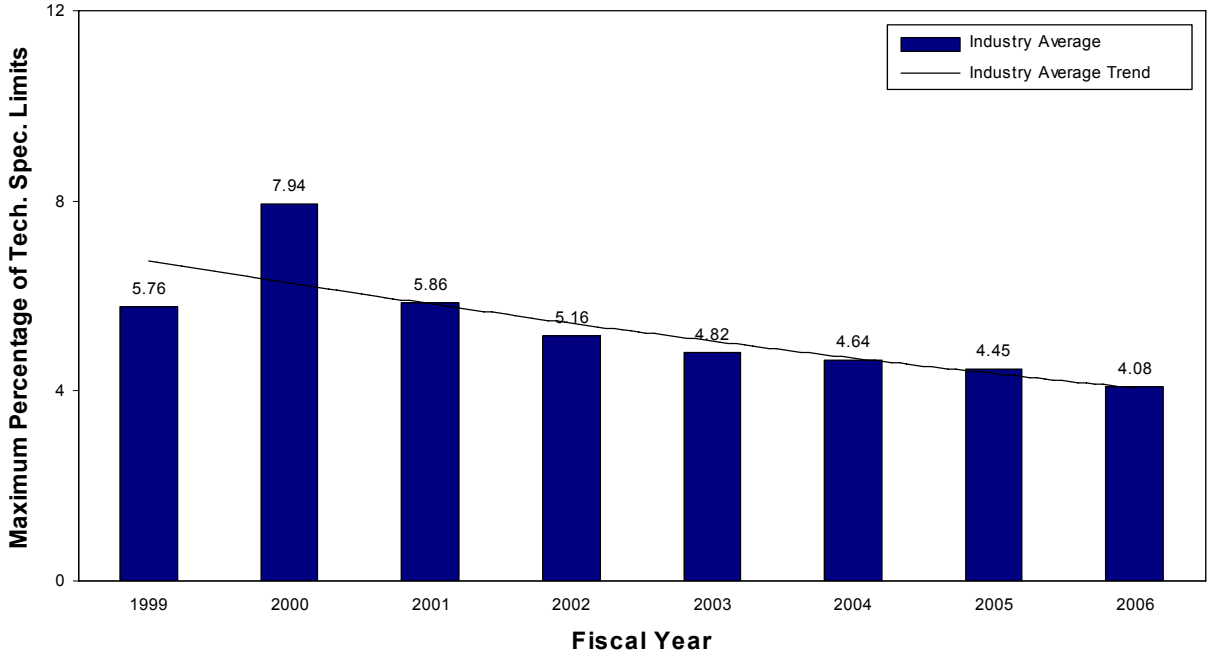
Unplanned Power Changes



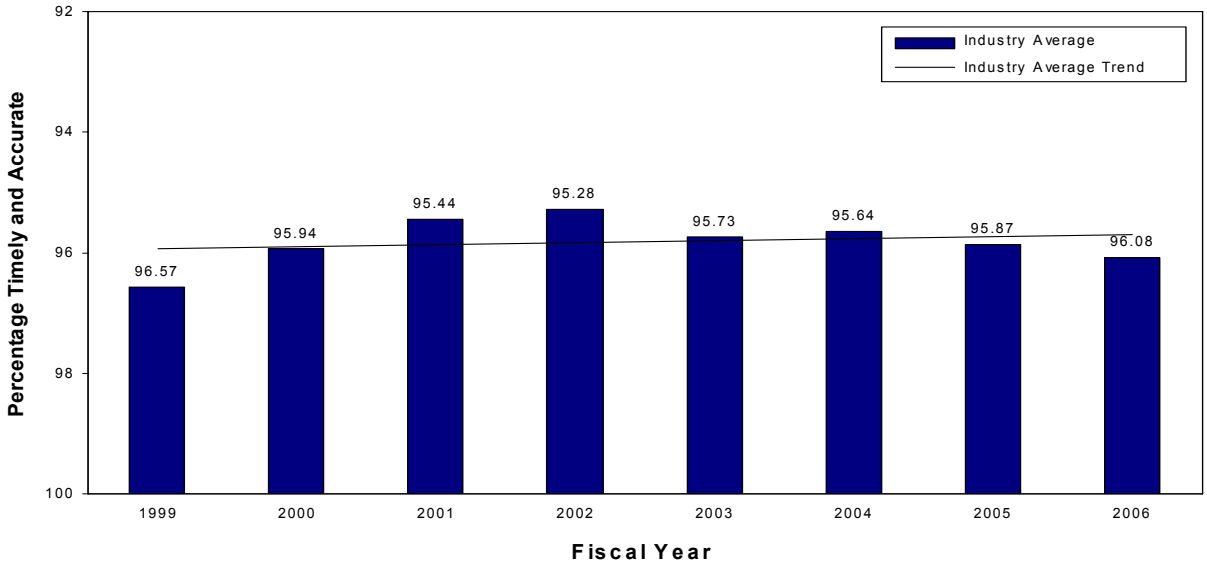
Reactor Coolant System Activity



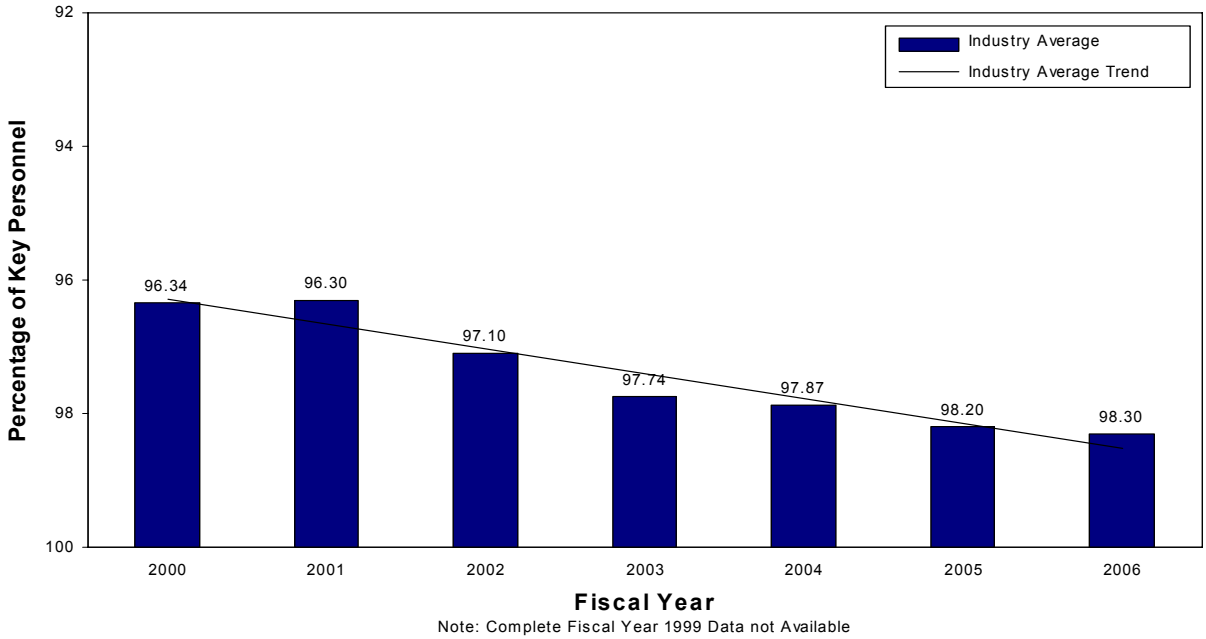
Reactor Coolant System Leakage



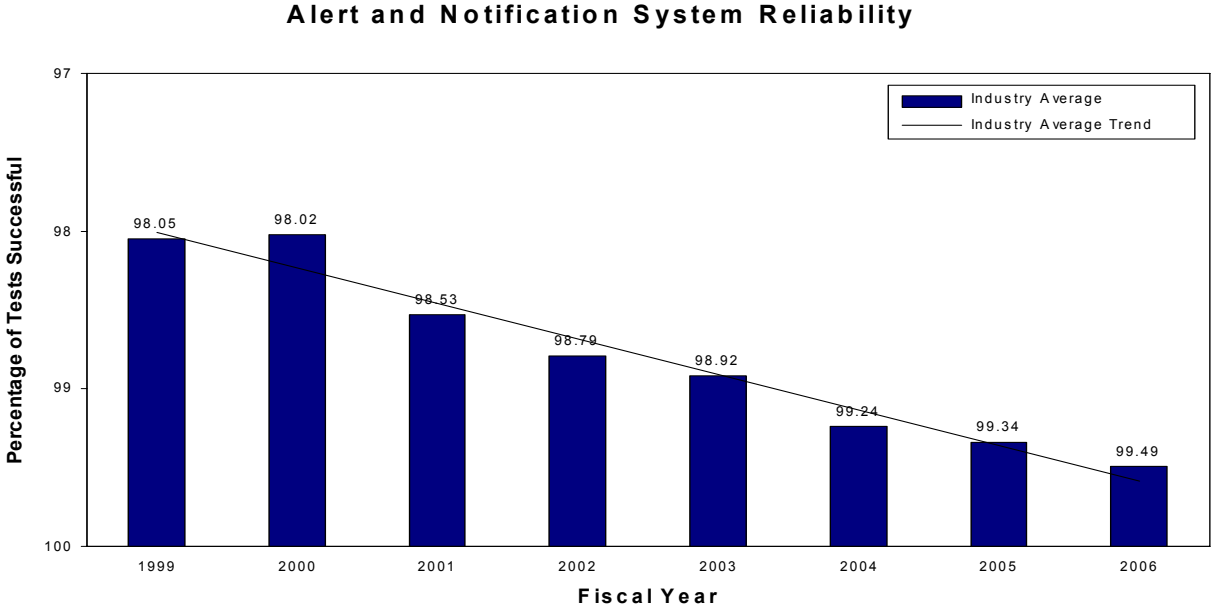
Drill/Exercise Performance



ERO Drill Participation



Note: Complete Fiscal Year 1999 Data not Available


Alert and Notification System Reliability
Industry Average
Industry Average Trend
Percentage of Tests Successful
97
98
99
100
98.05
98.02
98.53
98.79
98.92
99.24
99.34
99.49
1999
2000
2001
2002
2003
2004
2005
2006
Fiscal Year

Total Precursors

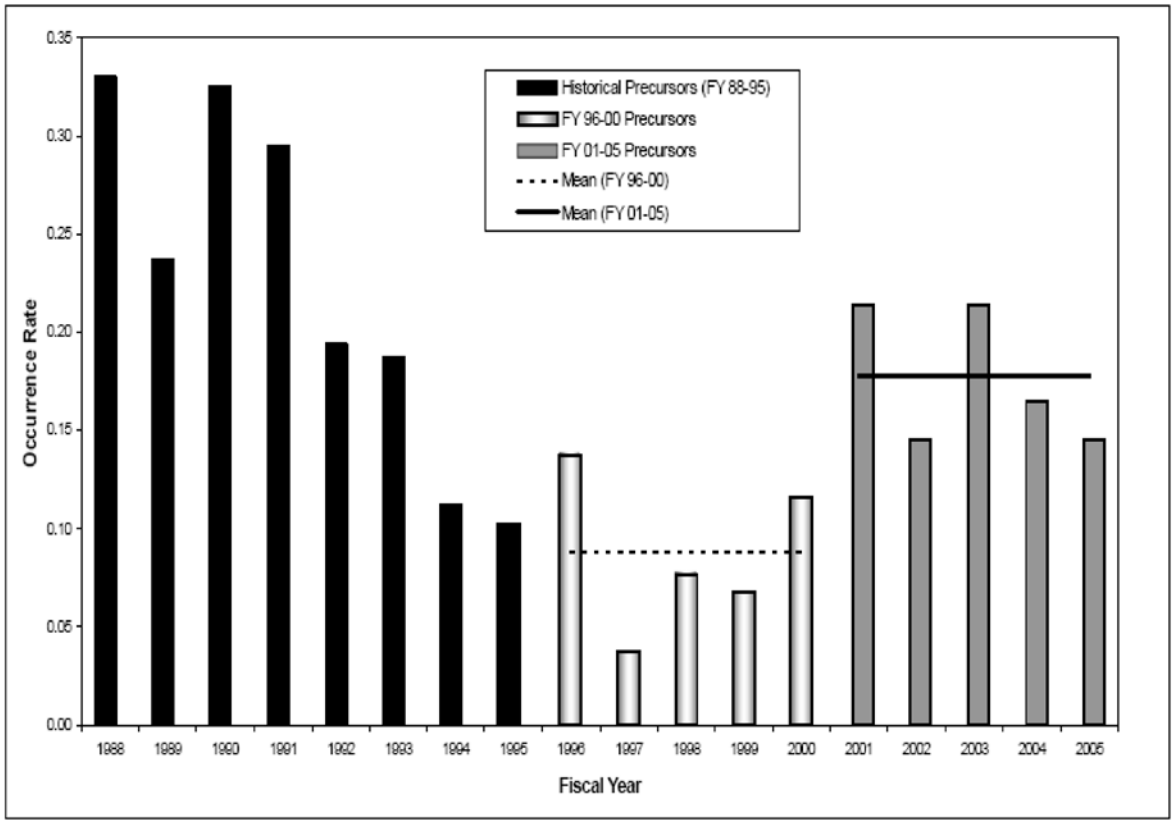
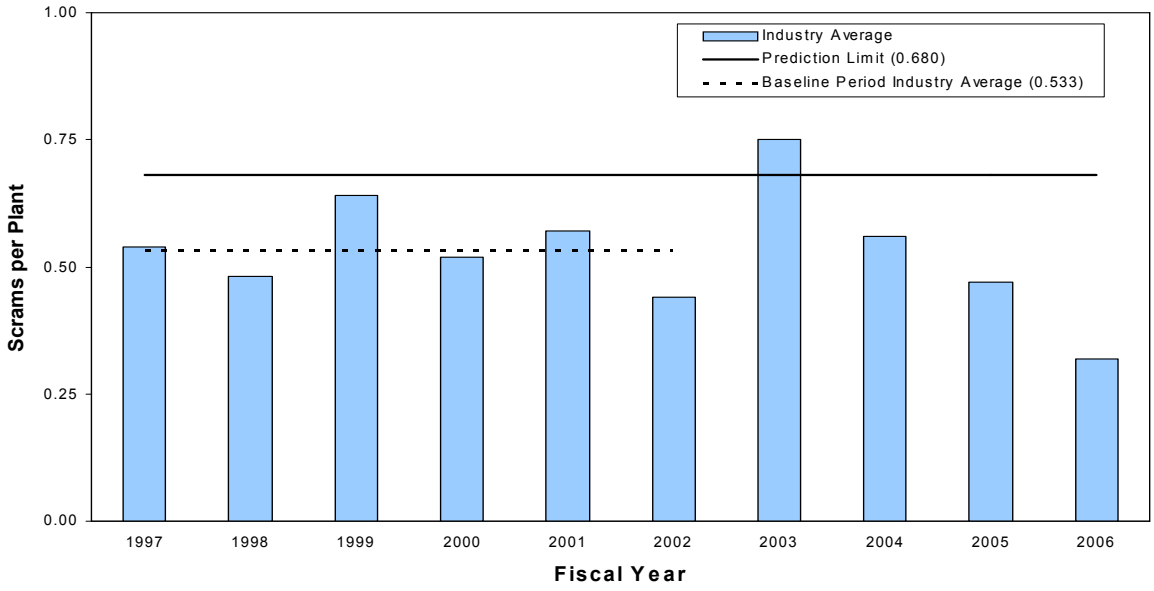


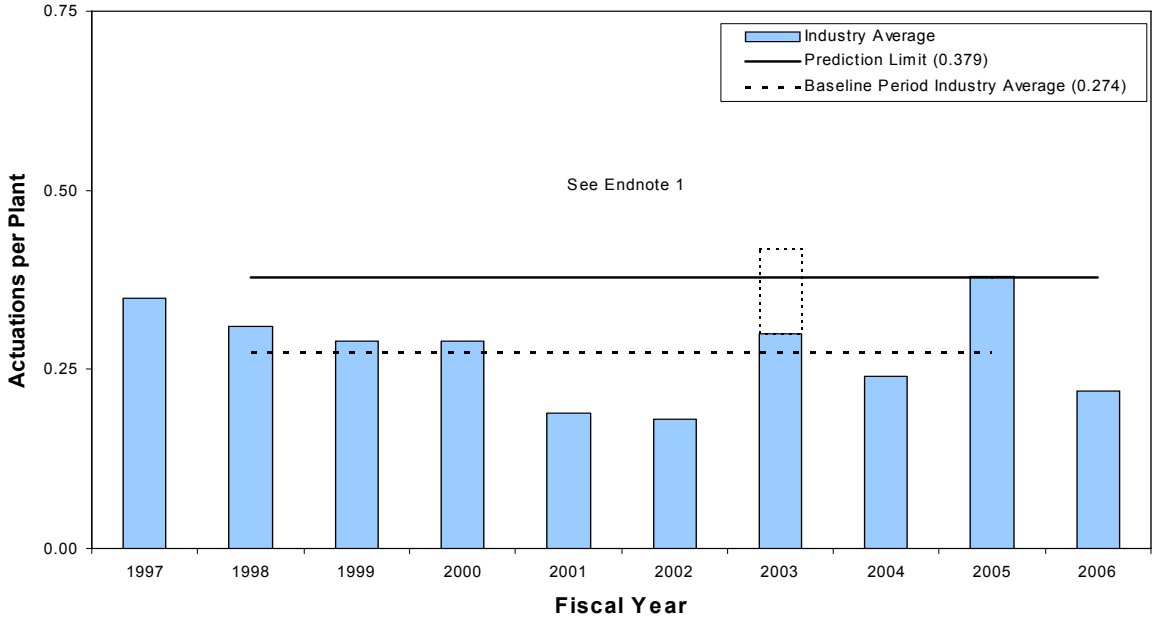
Figure 1: Total Precursors– occurrence rate, by fiscal year. Data for FY 1988 through FY 1995 are shown for historical perspective. Data from FY 2001 through FY 2005 represent the period with an increased ASP scope. No statistically significant trend (p-value = 0.8608) is detected during the FY 2001–2005 period. Data from FY 1996 through 2000 are charted separately since it is part of the data from within the last 10 years without the increase in ASP scope. No statistically significant trend (p-value = 0.3735) is detected during the FY 1996–2000 period.

FY 2006 Short-Term Industry Trends Results

Automatic Scrams While Critical

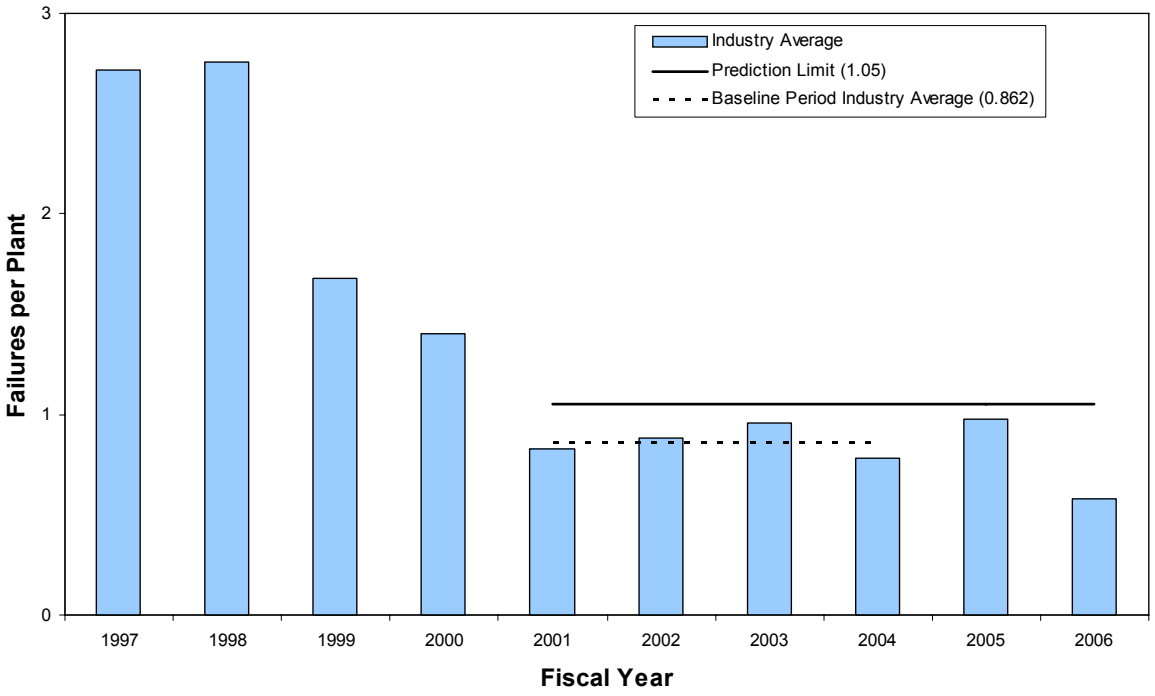


Safety System Actuations

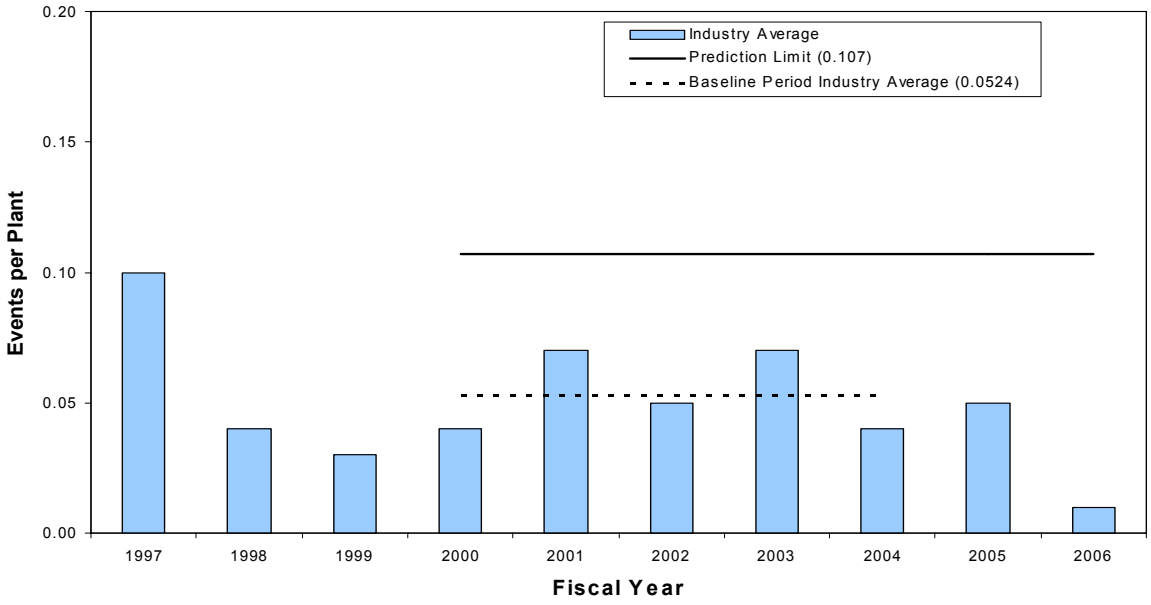


Enclosure 2

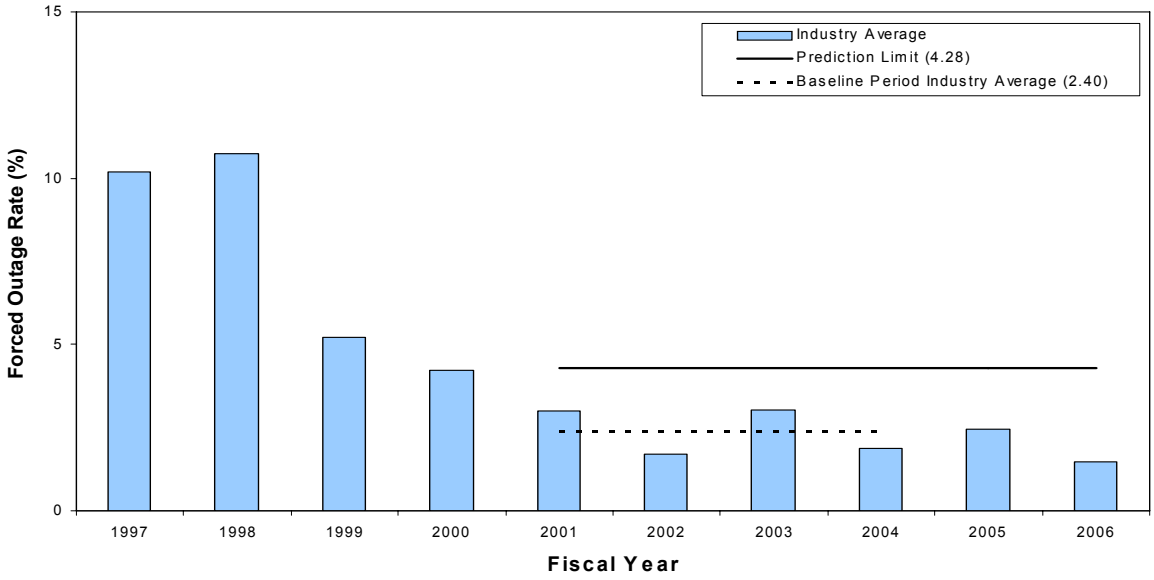
Safety Sytem Failures



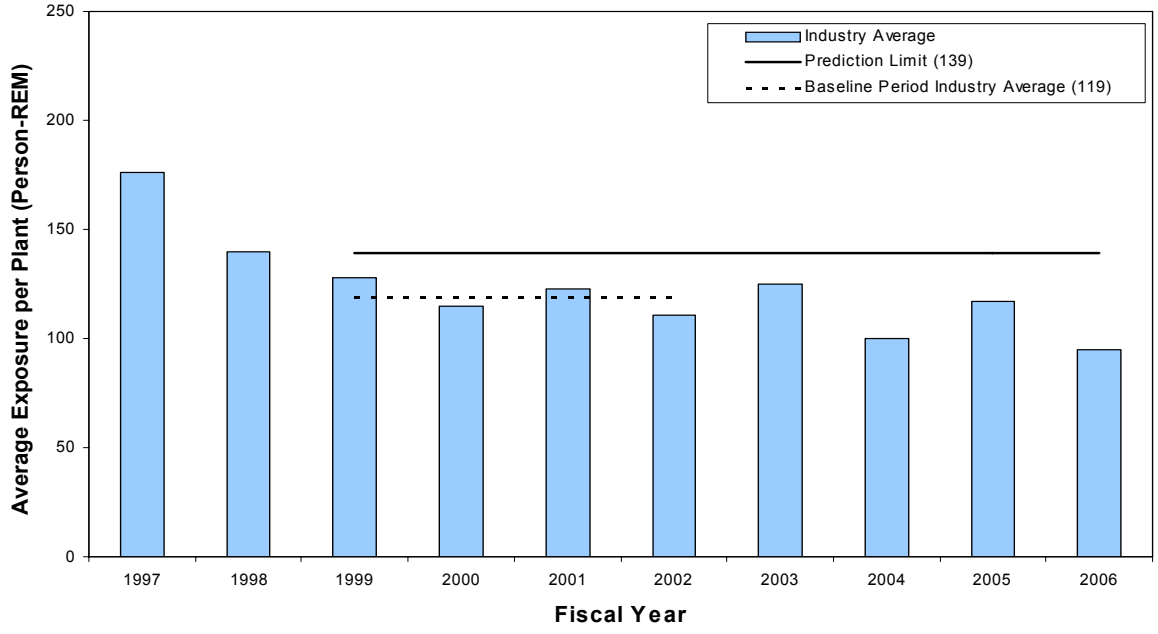
Significant Events



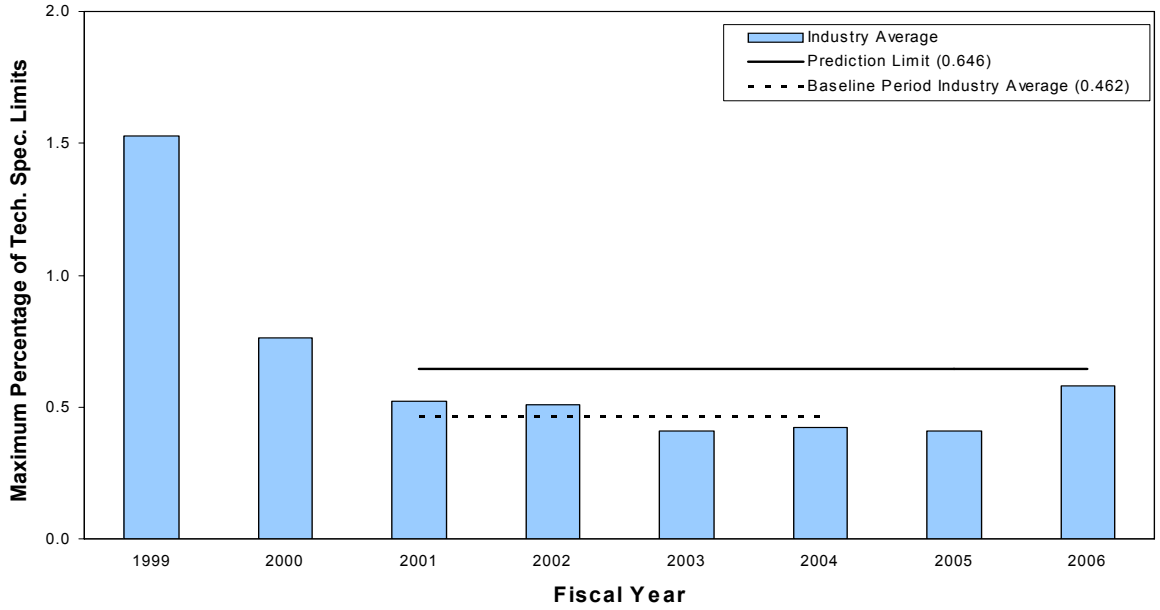
Forced Outage Rate



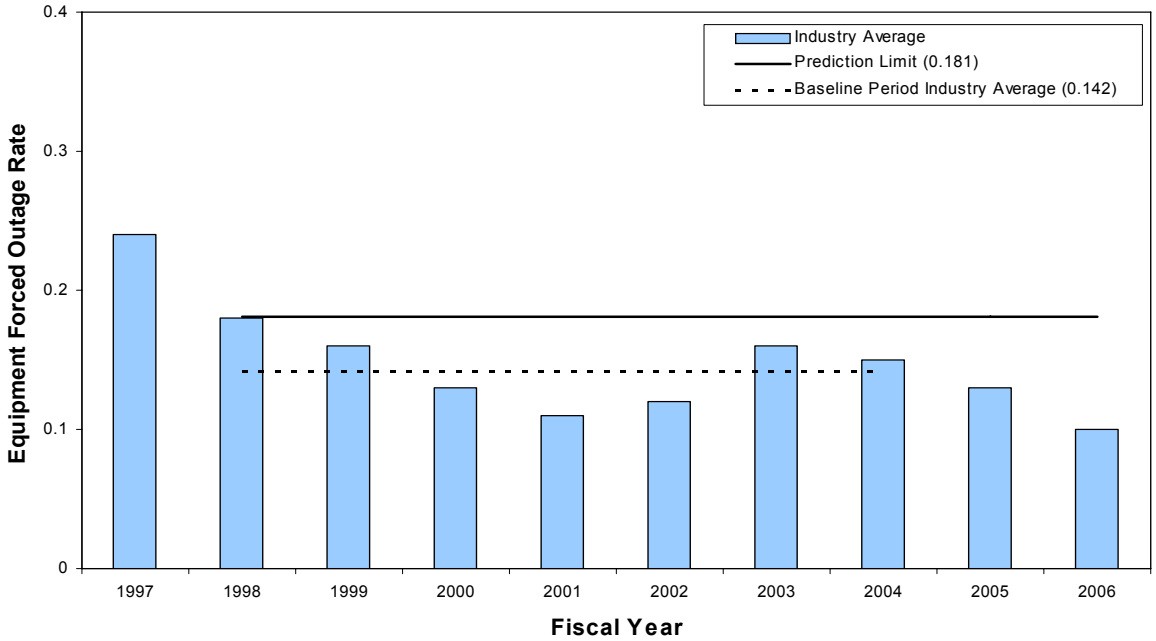
Collective Radiation Exposure



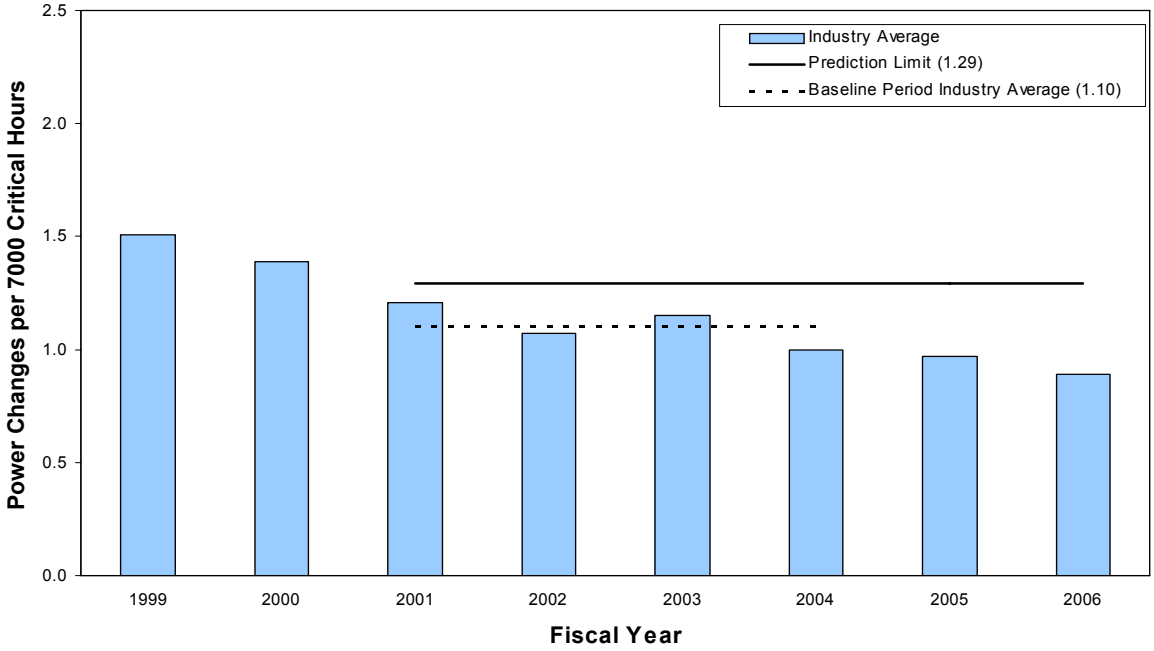
Reactor Coolant System Activity



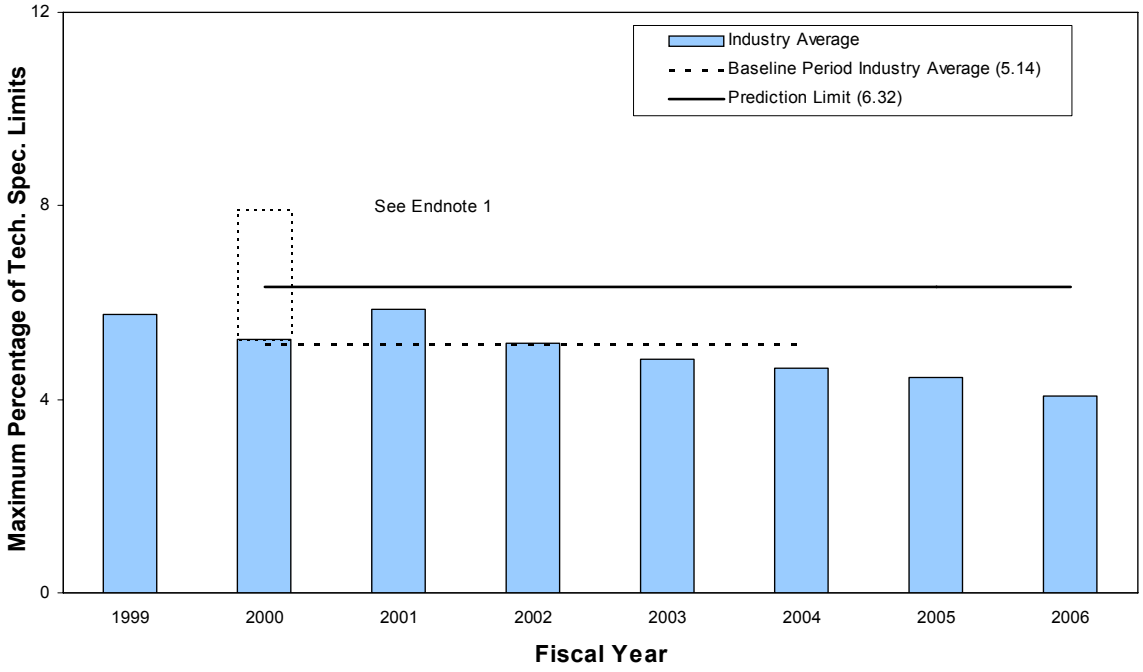
Equipment Forced Outages/1000 Commercial Critical Hours



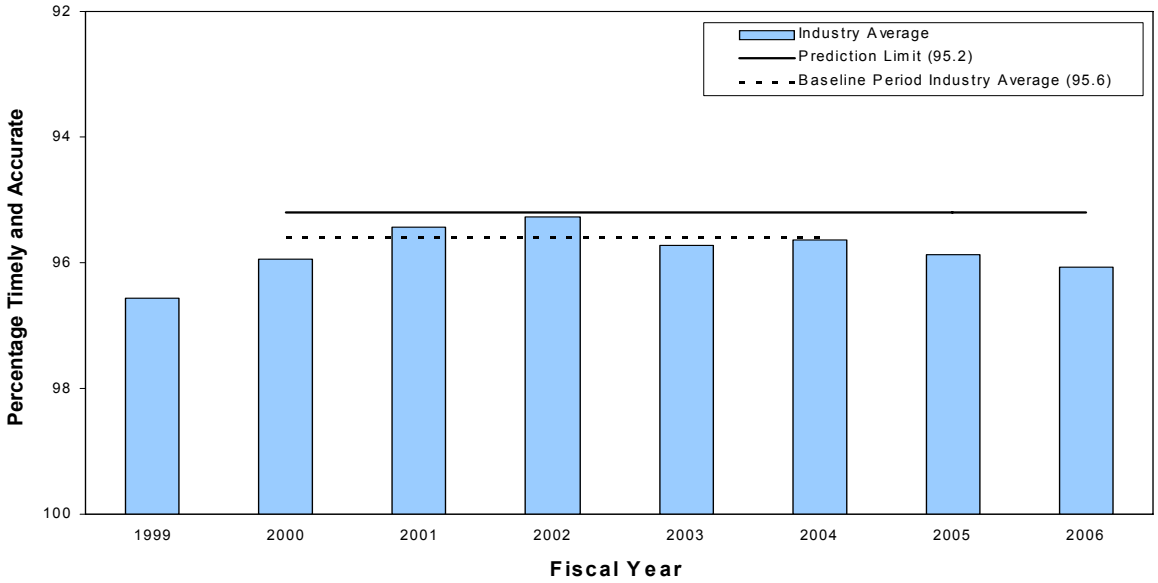
Unplanned Power Changes



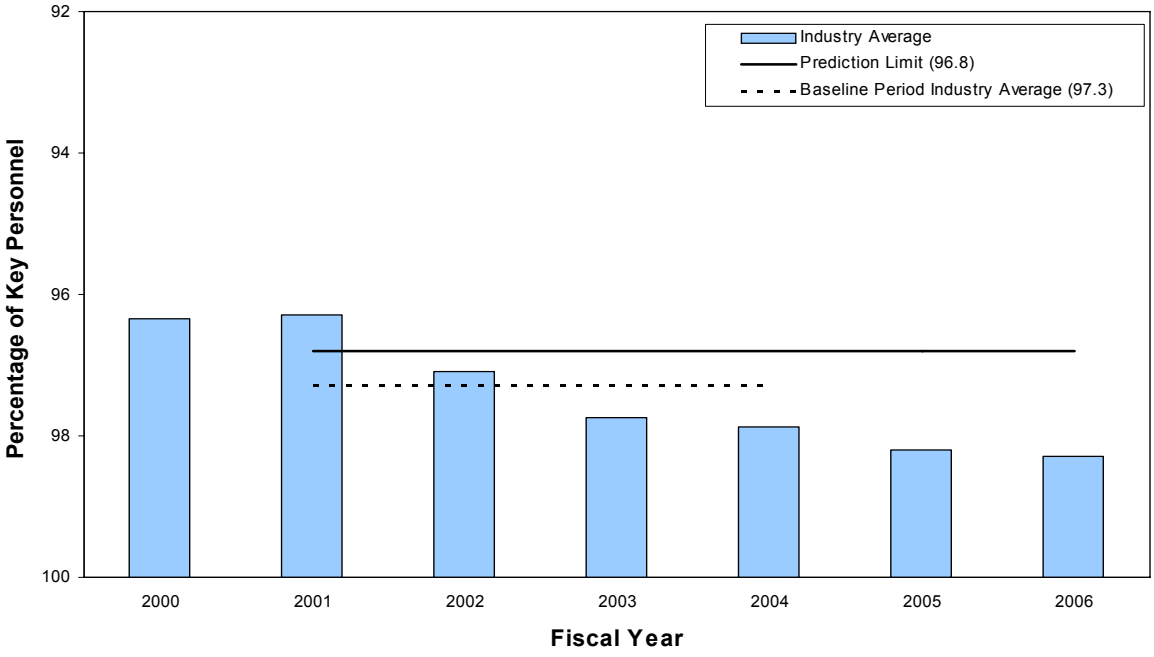
Reactor Coolant System Leakage

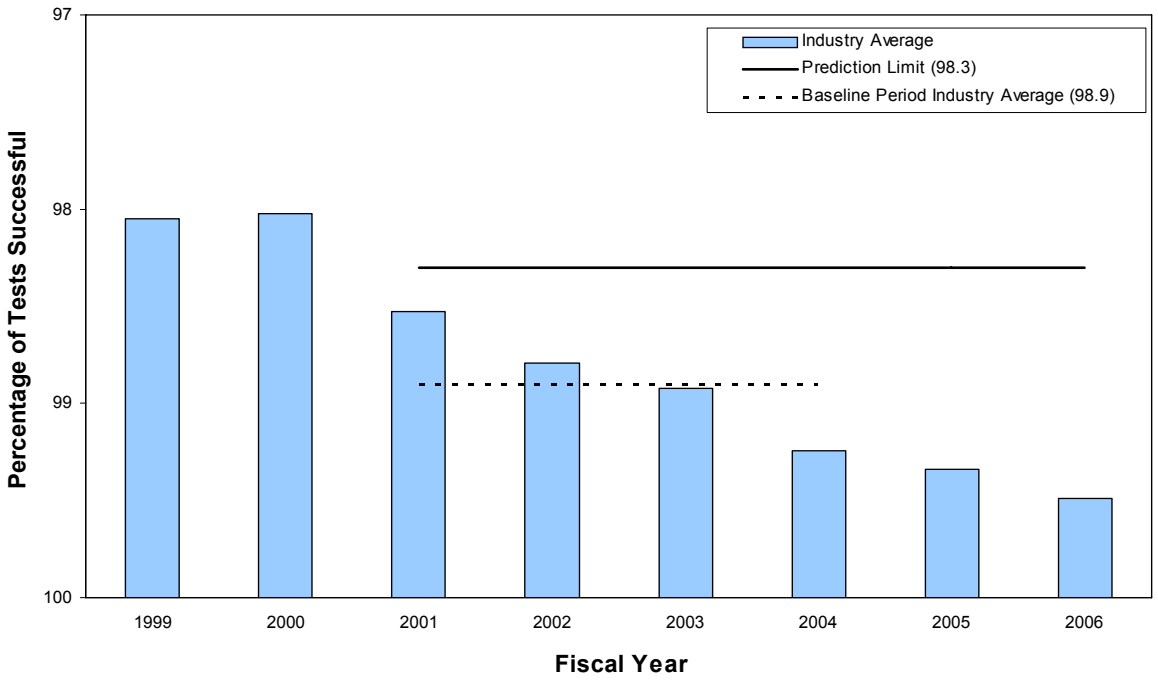


Drill/Exercise Performance



ERO Drill Participation





NOTE 1:
The 2003 blackout event in the Safety System Actuation graph and the 2000 Indian Point 2 steam generator tube rupture event in the Reactor Coolant System Leakage graph were not included in the short-term data for the purpose of determining prediction limits. These were excluded when developing the prediction limit models because they are considered outlier events that overly influenced the statistical analysis of the industry-wide data. Removing these events resulted in less restrictive prediction limits.