POLICY ISSUE
Information

April 5, 2016 SECY-16-0044

FOR: The Commissioners

FROM: William M. Dean, Director
Office of Nuclear Reactor Regulation

SUBJECT: FISCAL YEAR 2015 RESULTS OF THE INDUSTRY TRENDS PROGRAM FOR OPERATING POWER REACTORS

PURPOSE:

The purpose of this paper is to inform the Commission of the results of the U.S. Nuclear Regulatory Commission's (NRC's) industry trends program (ITP) for fiscal year (FY) 2015. In summary, the staff did not identify any statistically significant adverse trends in industry safety performance that required generic actions. This paper does not address any new commitments or resource implications.

BACKGROUND:

The staff established the ITP in 2001 to monitor trends in licensee safety performance using industry-level indicators. Should the staff identify any statistically significant adverse trends, further analysis would be conducted to determine whether the trends are unduly influenced by a small number of outliers and to identify any causal factors. If the trends are not a result of outliers in the data, adjustments to the NRC's inspection program may result. The NRC reviews the results of the ITP and any actions taken or planned as a result during the annual Agency Action Review Meeting. The NRC reports the findings of this review to the Commission during the subsequent Commission meeting.

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NRC Inspection Manual Chapter (IMC) 0313, "Industry Trends Program," dated January 26, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15316A039), contains details of the ITP including definitions of monitored indicators and program descriptions.

Using the ITP, the staff monitors industry-wide safety performance to identify and address any statistically significant adverse trends. A statistically significant adverse trend exists if the slope of the regression line fitted to the long-term indicator data has a positive value and the fit of the regression line is statistically relevant.

In addition to long-term indicators, the ITP uses a statistical approach based on prediction limits to identify potential short-term (year-to-year) emergent issues before they become long-term trends. The short-term prediction limits are determined from an established baseline period during which data can be regarded as fairly constant.

The ITP is designed to complement the Reactor Oversight Process (ROP). Specifically, the ITP monitors and responds to industry-wide performance, whereas the ROP provides oversight of individual reactor sites commensurate with their safety performance.

In 2008, the NRC staff established the Baseline Risk Index for Initiating Events (BRIIE) as part of the ITP. The BRIIE tracks several types of events that could potentially initiate a challenge to a plant's safety systems. Nine initiating event categories are monitored for boiling-water reactors and ten for pressurized-water reactors. The number of times that each event occurs is compared to a predetermined number of occurrences for that event. The predetermined number of occurrences is calculated using information from an established baseline period. If the predetermined number is exceeded, the staff assesses whether there is a possible degradation in overall industry safety performance. This annual tracking is intended to allow the NRC to intervene and engage the nuclear industry before any long-term adverse trends in performance emerge.

In 2016, the staff recommended elimination of the ITP in SECY-16-0009, "Recommendations Resulting from the Integrated Prioritization and Re-Baselining of Agency Activities." This recommendation noted that while the ITP provides data that helps to validate broad industry performance trends, no regulatory action has ever resulted from ITP insights. In considering the cost of the program, staff noted that any negative trends in performance that the ITP might highlight could be self-revealing or identified through other means. If the Commission approves elimination, licensee submittal of data will not be affected, but this will be the final ITP report.

DISCUSSION:

Status of Changes to the ITP

On June 13, 2013, the Commission issued a staff requirements memorandum (SRM) in response to the May 29, 2013, "Briefing on the Results of the Agency Action Review Meeting (AARM)." In this SRM the Commission directed the staff to review the ITP as follows:

> As part of the Reactor Oversight Process (ROP) Self-Assessment for calendar year (CY) 2013, the staff should review implementation of the Industry Trends Program over its

history for lessons learned and inform the Commission of any program enhancements and/or resource reductions that may be warranted.

After completing the review of the ITP in 2013, the staff committed in SECY-14-0042, "Fiscal Year 2013 Results of the Industry Trends Program for Operating Power Reactors," to evaluate including new indicators measuring industry performance in ROP cornerstones that had not previously been measured, such as the public radiation safety cornerstone and the security cornerstone. The staff also committed to evaluating the possibility of supplementing or replacing ITP indicators with ROP performance indicators (PIs), where applicable.

In 2015, the staff completed these evaluations. The staff determined that shifting from ITP indicators to ROP PIs and including indicators representing all cornerstones would provide the following advantages:

- A more holistic view of industry safety performance would be achieved because all cornerstones of the ROP would be evaluated;

- data collection would be more efficient and the time lag of some of the ITP indicators would be reduced;

- the significant resource burden (i.e., contract support) related to data collection and analysis would be greatly reduced; and

- the ITP would be more understandable by using the ROP PIs because the ROP PIs are more commonly used and widely disseminated.

Based on the staff's evaluation, IMC 0313 was revised on January 26, 2016, to replace ITP indicators with ROP PIs.

Development of the methods to conduct statistical analysis and to establish prediction limits for these new indicators is ongoing and will be completed in 2016. This paper presents both the results for the new indicators that have a completed statistical analysis, as well as the results for indicators which have recently been replaced by the IMC 0313 revision. The previous revision of IMC 0313, "Industry Trends Program," dated May 29, 2008 (ADAMS Accession No. ML080860540), contains definitions and details on these ITP indicators that were recently replaced.

This paper contains four enclosures. As with previous ITP papers, the first three enclosures provide the results for the review of long-term trends, short-term comparison to prediction limits, and the BRIIE for FY 2015. In order to provide continuity during the transition to new indicators for the ITP, this paper also includes a fourth attachment with results for long-term and short-term analysis of the ITP indicators that are being replaced and will no longer be used going forward.

Results of FY 2015 Long-Term Industry Trends

For FY 2015, the staff did not identify any statistically significant adverse trends using the revised indicators. The graphs in enclosure 1 show the long-term ITP indicator trends. Five indicators showed statistically significant improving trends. Trend lines are provided for those

indicators with a statistically significant trend. The staff evaluated both linear and exponential trend lines for each set of data and used the trend line showing the highest degree of statistical significance.

Results of FY 2015 Short-Term Industry Performance

As described above, 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 results and prediction limits for each of the revised indicators where statistical analysis is complete. None of the indicators exceeded their prediction limits in FY 2015. Short-term FY 2015 data did not reveal any emerging trends that warranted additional analysis or significant adjustments to the nuclear reactor safety inspection or licensing programs.

Results of FY 2015 Baseline Risk Index for Initiating Events

Enclosure 3 includes the BRIIE results for FY 2015. None of the tracked initiating events exceeded their prediction limits.

Results of FY 2015 Replaced Indicators

The ITP indicators were revised in January 2016 and some statistical analyses for the new indicators remains to be completed. During this transition period the staff also reviewed the indicators that were recently removed from the ITP. Enclosure 4 shows the long-term and short-term results for these indicators.

None of the short-term indicators exceeded their prediction limits in FY 2015. However, a statistically significant adverse trend was observed for the Safety System Failures (SSF) long-term indicator during the FY 2006 to FY 2015 timeframe.

This statistically significant adverse trend did not result from an unusually high FY 2015 value. In fact, SSF values have been relatively constant around the baseline period average for the last six FYs (2010 to 2015). The statistically significant adverse trend was caused by the ten year plot for SSFs now beginning with FY 2006 data. FY 2006 to FY 2009 values are the lowest in the 28 year history of the SSF indicator and are the only years in the history of the ITP in which the SSF values vary significantly from the baseline average, so they are considered to be outliers by the ITP. The unusually good performance in SSFs during the FY 2006 to FY 2009 timeframe combined with the return to historically normal levels of performance during the FY 2010 to FY 2015 timeframe strongly influence the data and cause a statistically significant adverse trend. Since this trend was caused by outliers in the data, it does not require any generic actions, as outlined in IMC 0313.

The Safety System Functional Failure (SSFF) ROP PI is one of the new indicators for which the full statistical analysis has yet to be completed and will be included in next year's industry trends analysis. Given its similarity to the SSF indicator, it is possible that the new SSFF indicator would have displayed a similar adverse trend.

CONCLUSION:

The FY 2015 ITP evaluation did not indicate any trends in industry safety performance that required generic actions. Also, no ITP indicator or initiating events tracked by the BRIIE exceeded their prediction limits.

RESOURCES:

The resources for ITP activities are included in the FY 2016 Current Estimate (CE) and the FY 2017 Congressional Budget Justification (CBJ). The total resources that are included in both the FY 2016 CE and FY 2017 CBJ are 0.5 full-time equivalent (FTE) and $535K. No additional resources beyond those already budgeted will be required for the ITP. Staff has proposed elimination of the ITP as outlined in SECY-16-0009, "Recommendations Resulting from the Integrated Prioritization and Re-Baselining of Agency Activities," and will await Commission direction from that paper. If the Commission approves the reduction, the 0.5 FTE and the portion of the $535k contract dollars associated with the ITP in the FY 2017 CBJ will be cut. If the program is maintained, resources beyond FY 2016 will be addressed during the Planning, Budgeting, and Performance Management process.

COORDINATION:

The Office of the Chief Financial Officer has reviewed this paper for resource implications and has no objections. The Office of the General Counsel has reviewed this paper and has no legal objection.

/RA/

William M. Dean, Director
Office of Nuclear Reactor Regulation

Enclosures:
1. Fiscal Year 2015 Long-Term Industry Trend Results
2. Fiscal Year 2015 Short-Term Industry Performance
3. Summary of Baseline Risk Index for Initiating Events: Annual Graphs through Fiscal Year 2015
4. Fiscal Year 2015 Results for Recently Replaced Industry Trend Indicators

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ADAMS Accession Number: ML16050A462 ***concurred via email**

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FISCAL YEAR 2015 LONG-TERM INDUSTRY TREND RESULTS

The staff of the U.S. Nuclear Regulatory Commission did not identify any statistically significant adverse trends in the industry trends program performance indicator data from the most recent 10 years (fiscal years 2006–2015), as shown by the figures below.

As a reminder, the statistical analysis for some of the newly implemented ITP indicators is still ongoing and will be completed during calendar year 2016. This paper presents results for the ITP indicators that have a completed statistical analysis.

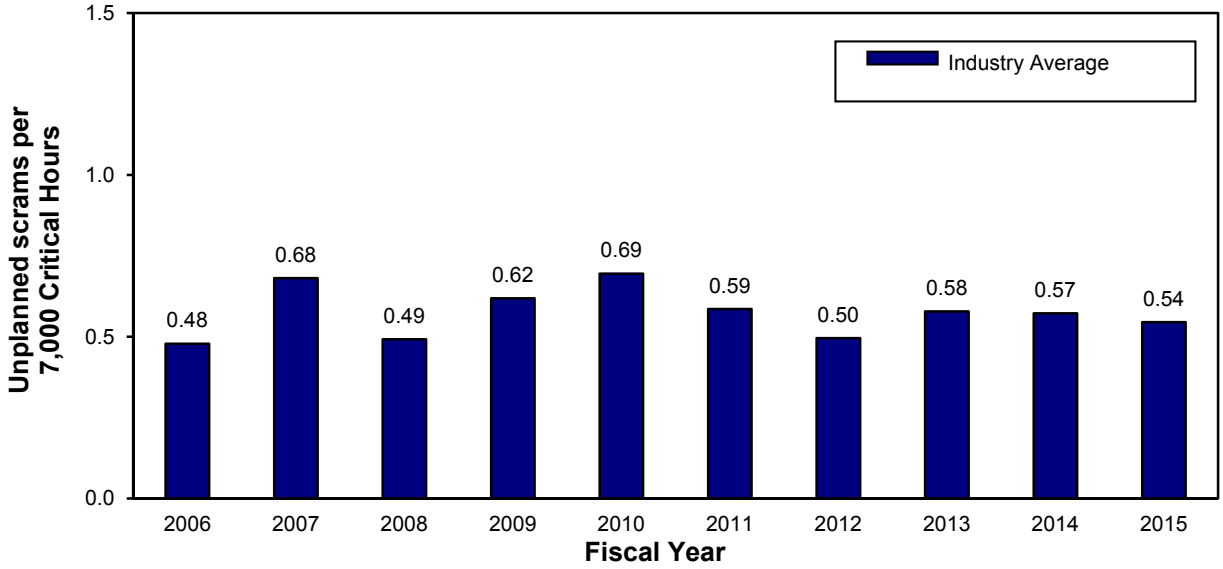


Figure 1. Unplanned scrams

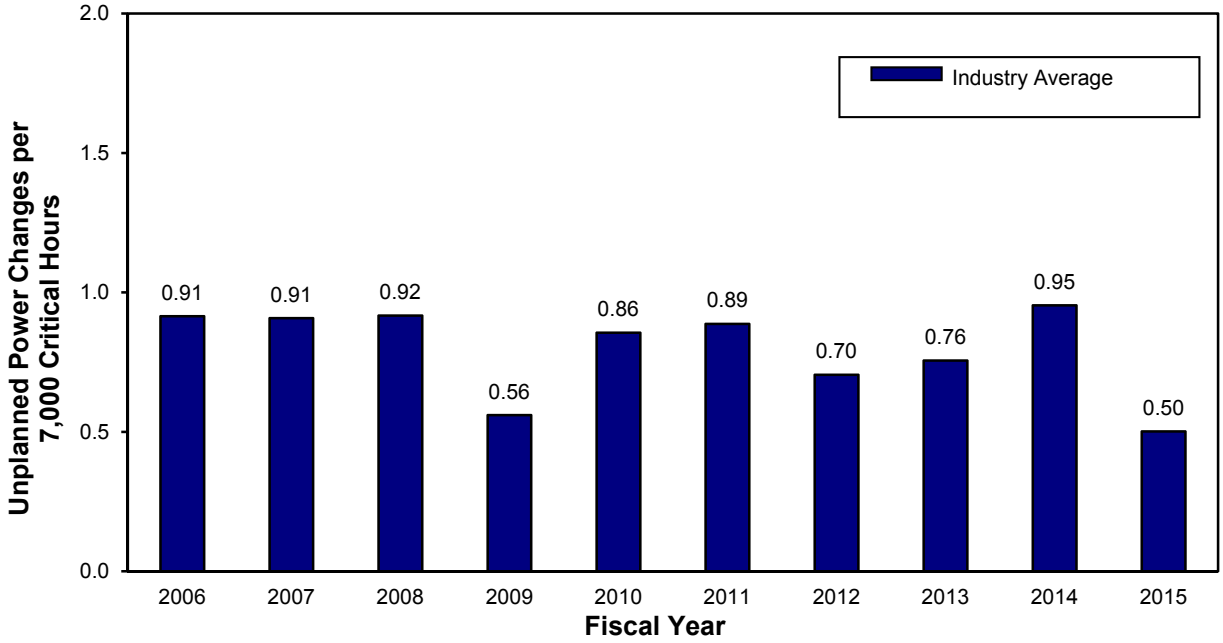


Figure 2. Unplanned power changes

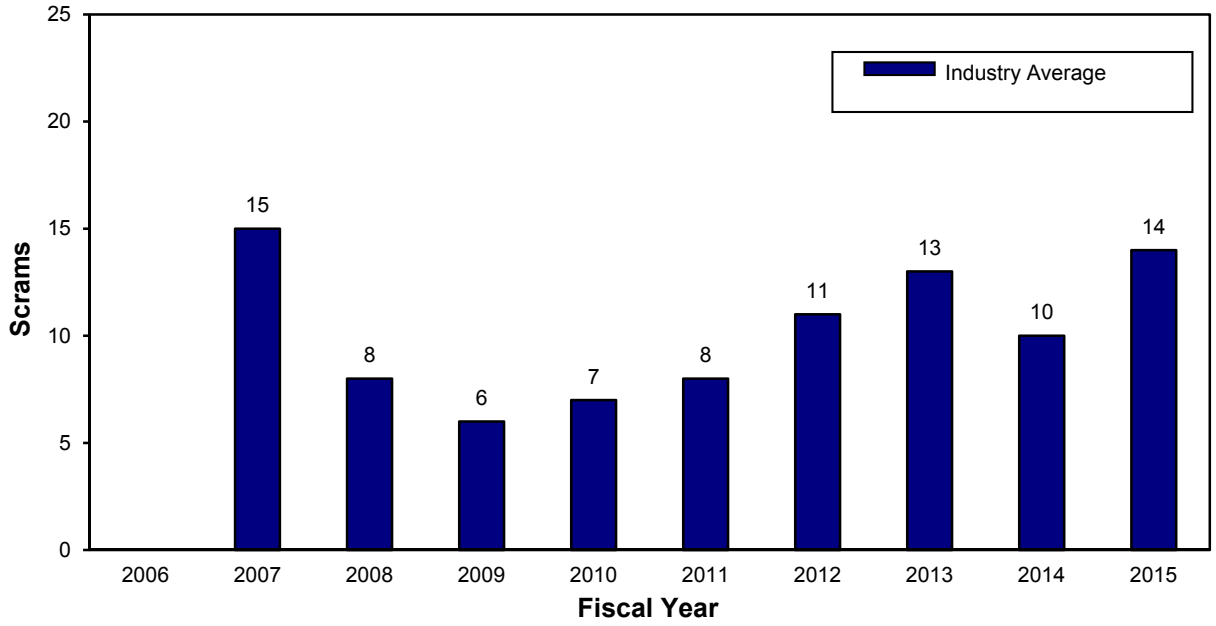


Figure 3. Unplanned scrams with complications

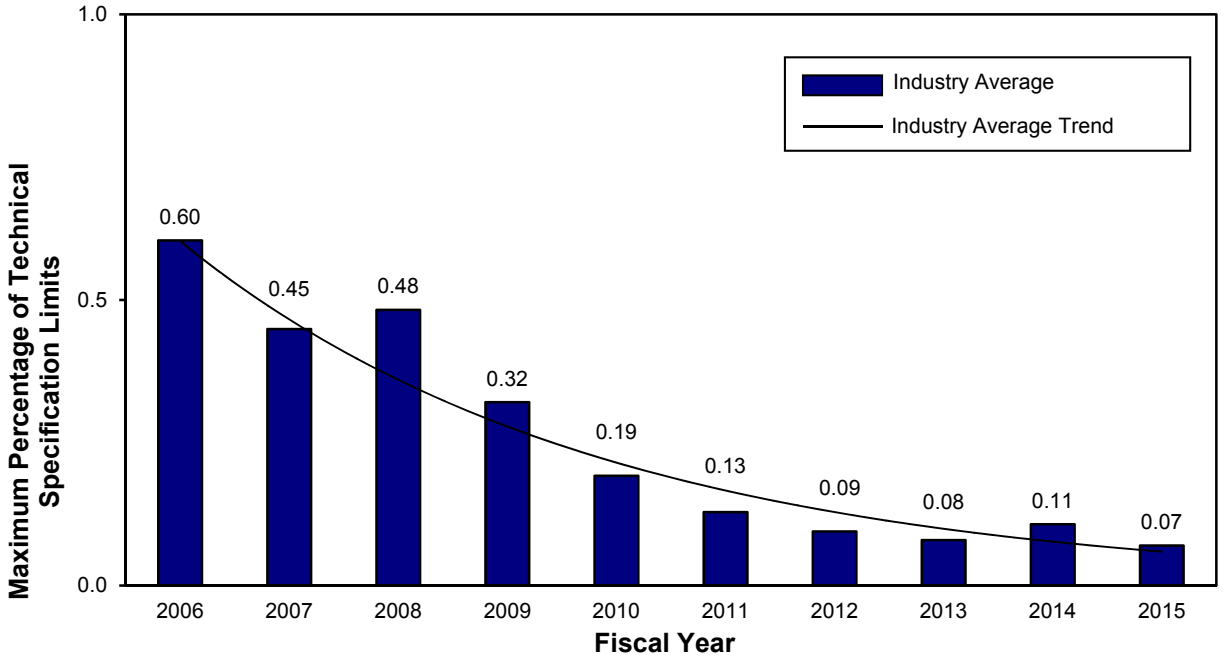


Figure 4. Reactor coolant system activity

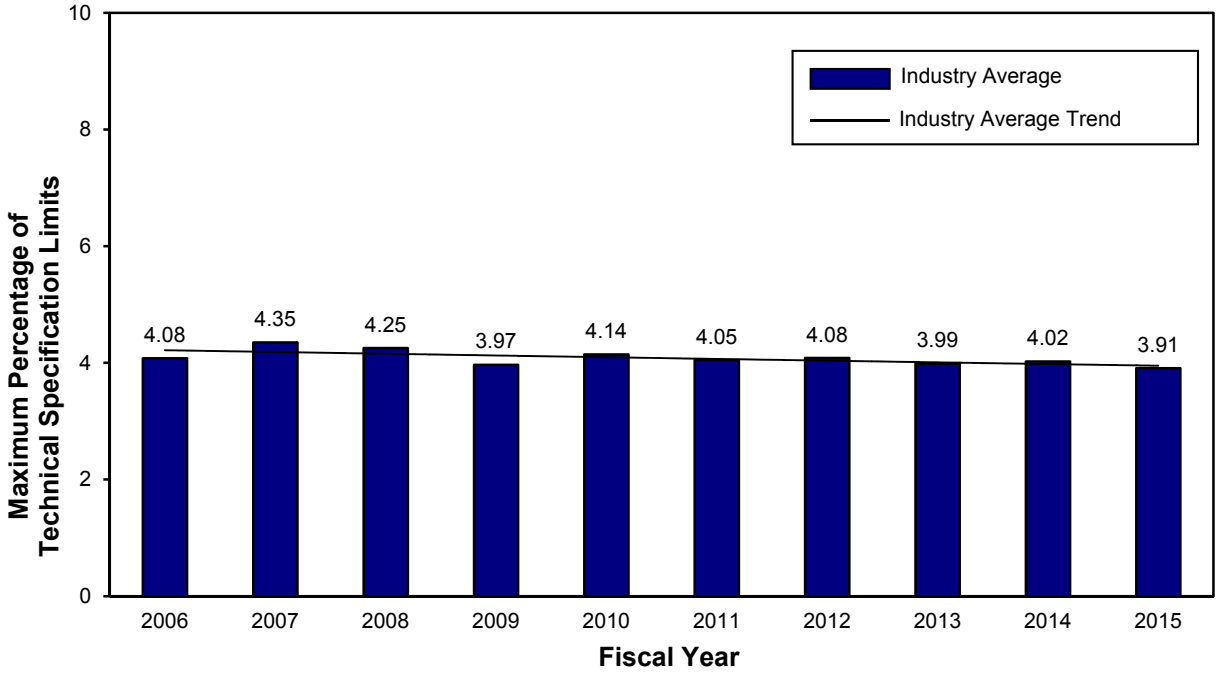


Figure 5. Reactor coolant system leakage

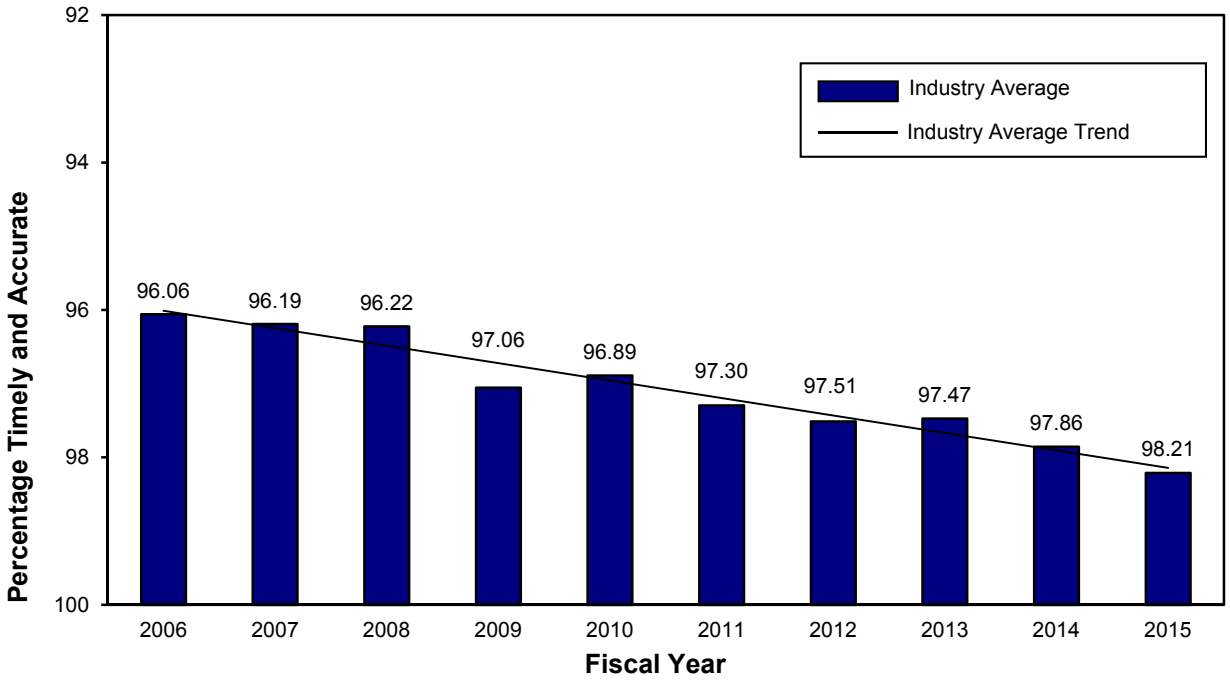


Figure 6. Drill and exercise performance

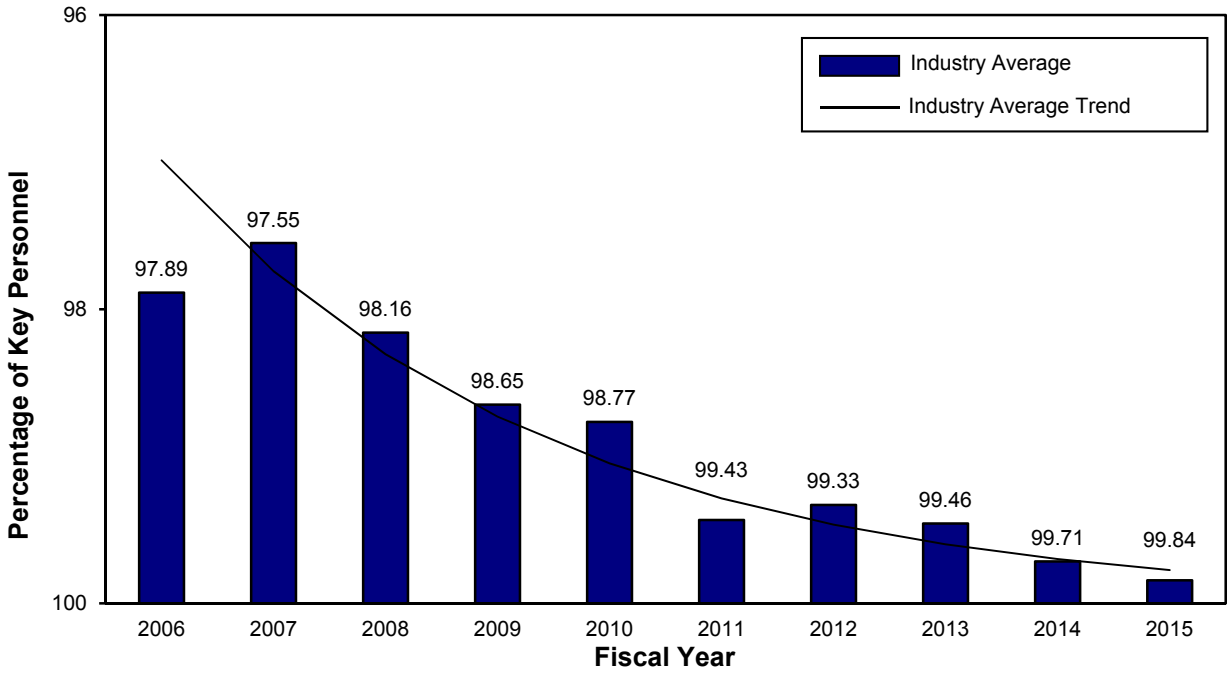


Figure 7. Emergency response organization drill participation

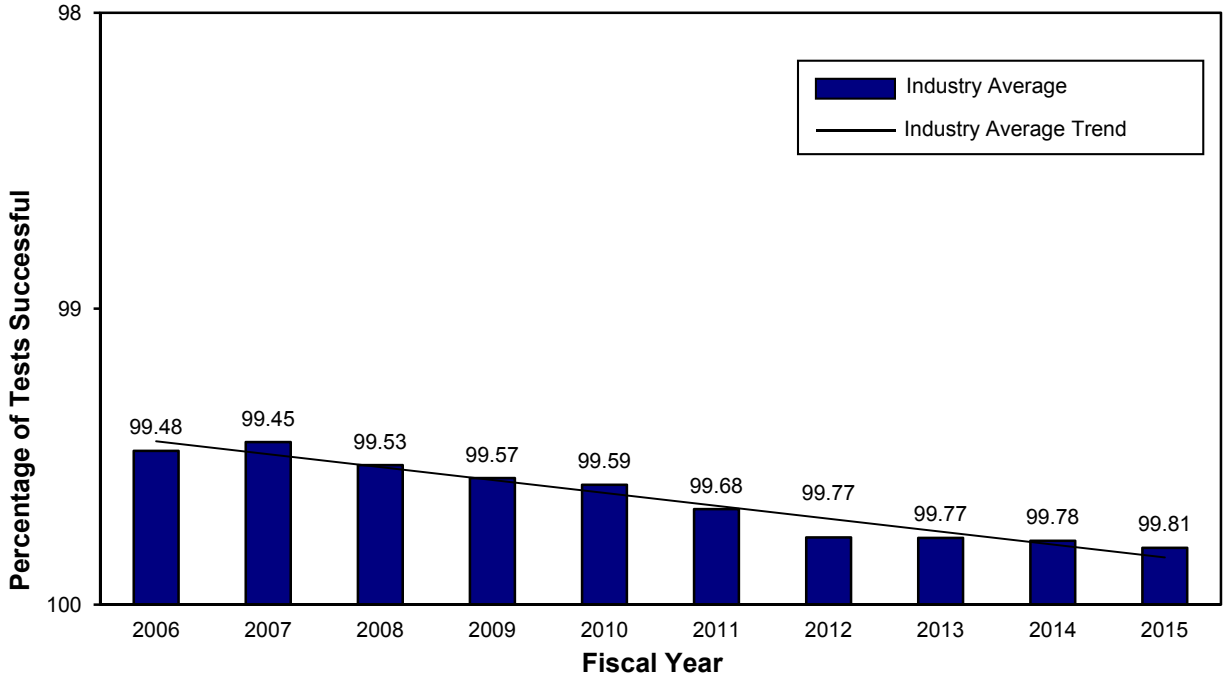


Figure 8. Alert and notification system reliability

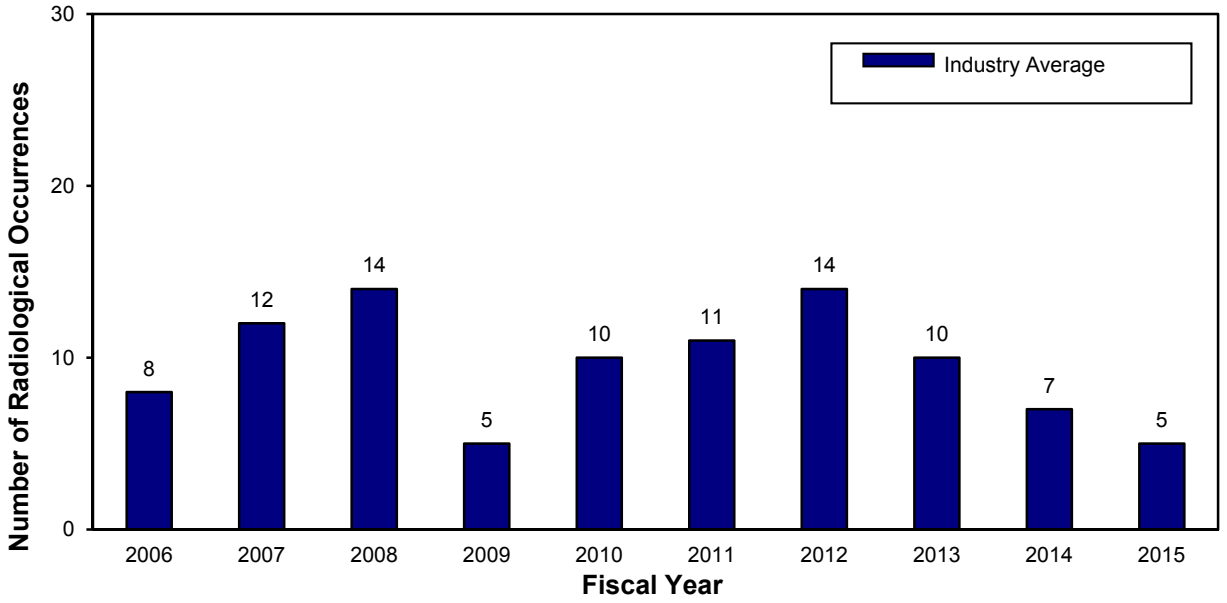


Figure 9. Occupational exposure control effectiveness

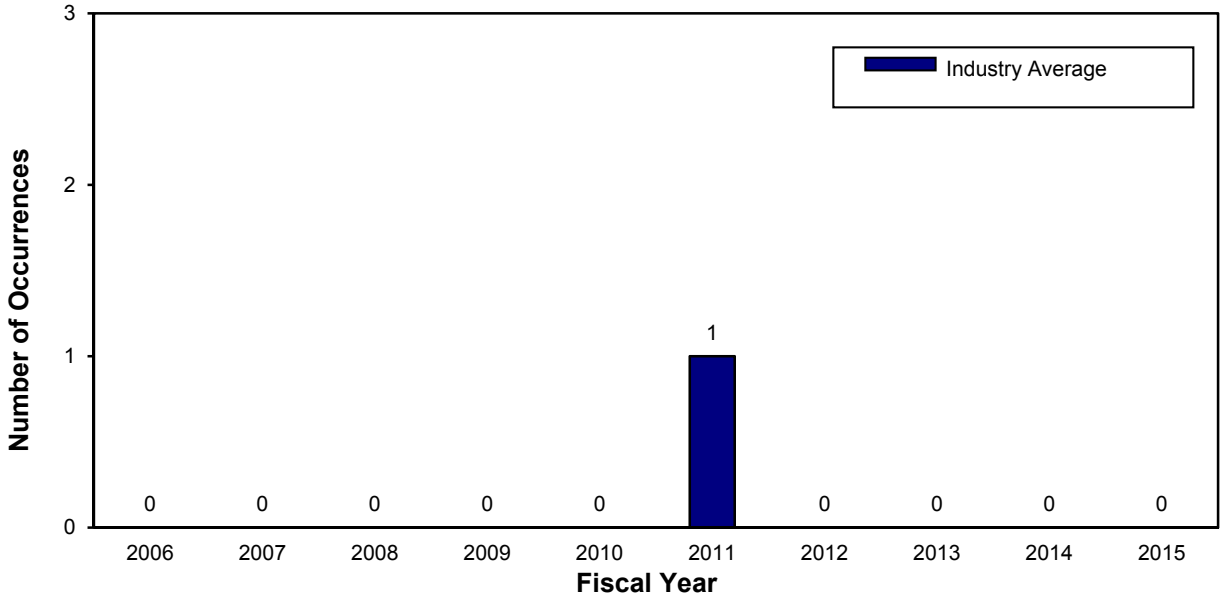


Figure 10. Radiological effluent technical specifications and offsite dose calculations manual radiological effluent occurrences

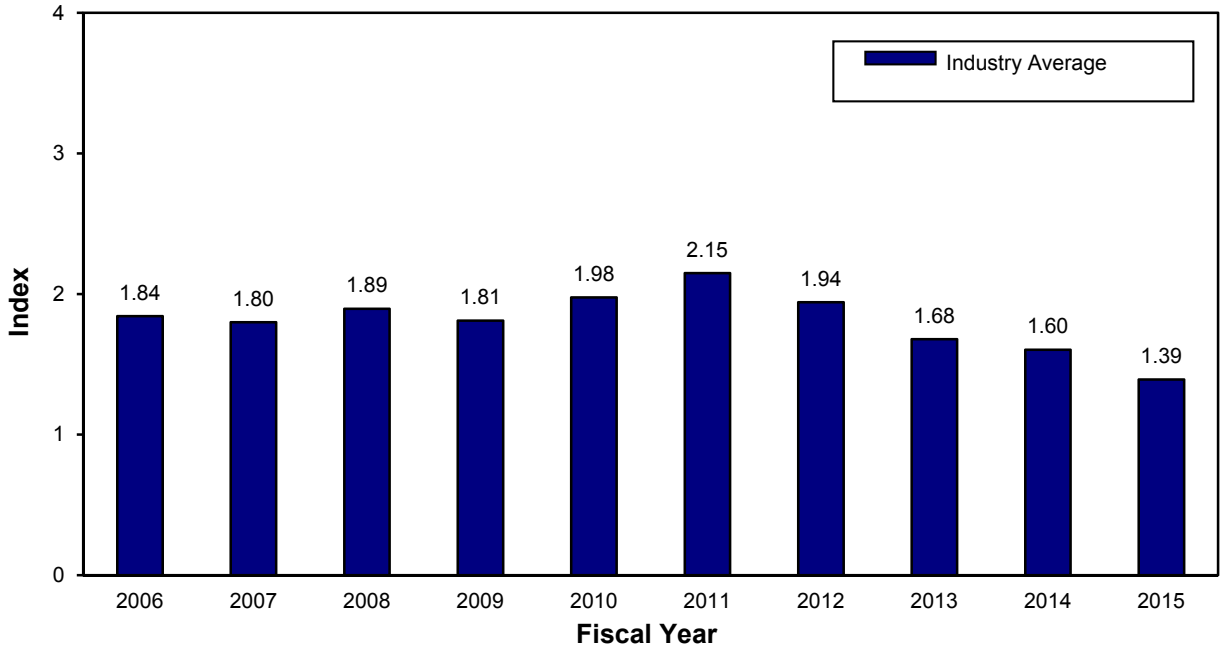


Figure 11. Protected area security equipment performance index

FISCAL YEAR 2015 SHORT-TERM INDUSTRY PERFORMANCE

The annual industry trend analysis compares 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 indicator. Baseline periods are periods for each indicator during which the data can be regarded as fairly constant and indicative of "current" performance.

The results of the evaluation for fiscal year (FY) 2015 Industry Trends Program (ITP) indicators, using the established prediction limits, show that no indicator exceeded its associated prediction limit in FY 2015, as shown in the figures below.

As a reminder, the statistical analysis for some of the newly implemented ITP indicators is still ongoing and will be completed during calendar year 2016. This paper presents results for the ITP indicators that have a completed statistical analysis, therefore no short-term graphs are shown for indicators which do not have a finalized prediction limit.

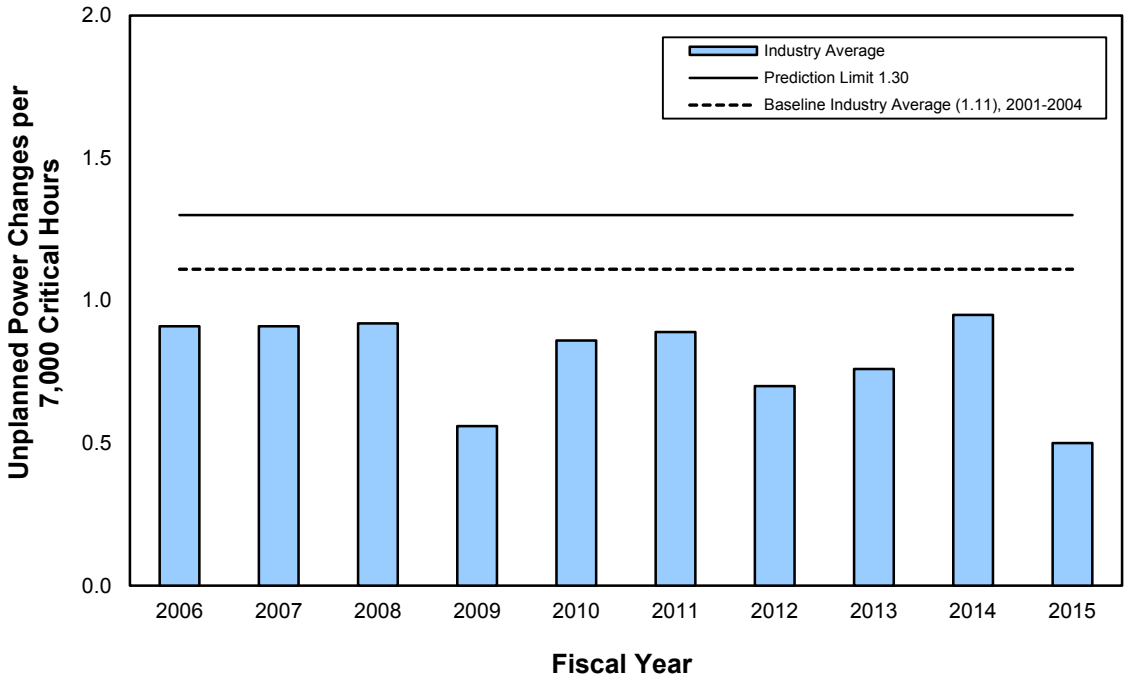
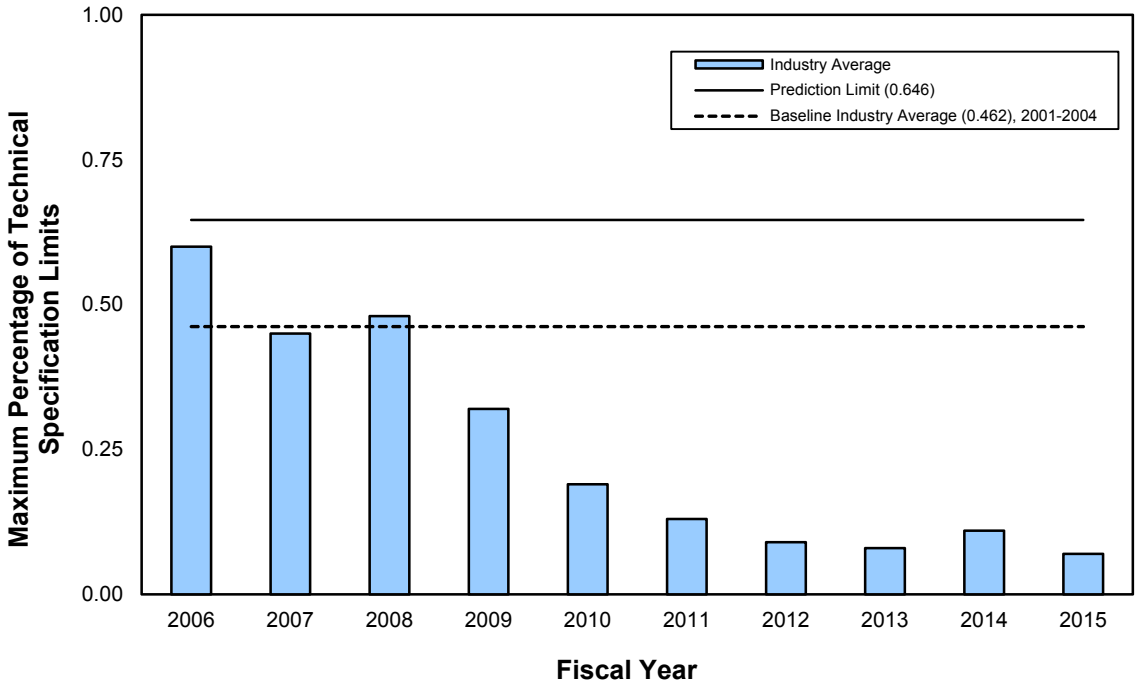


Figure 1. Unplanned power changes per 7,000 critical hours



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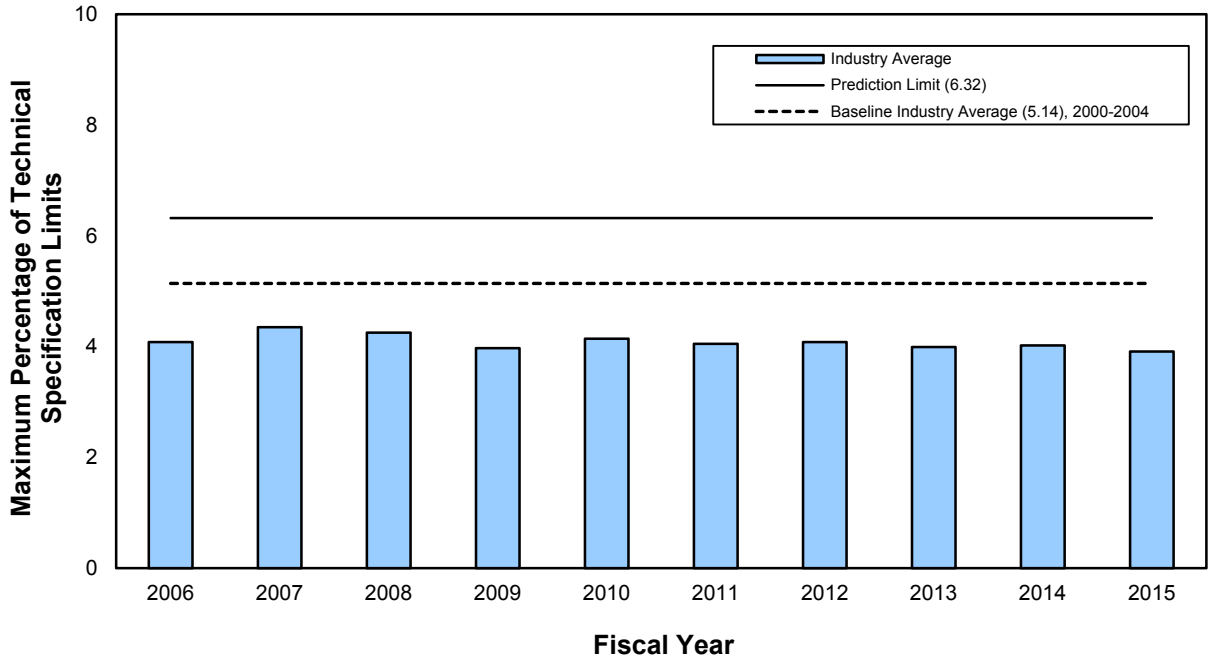
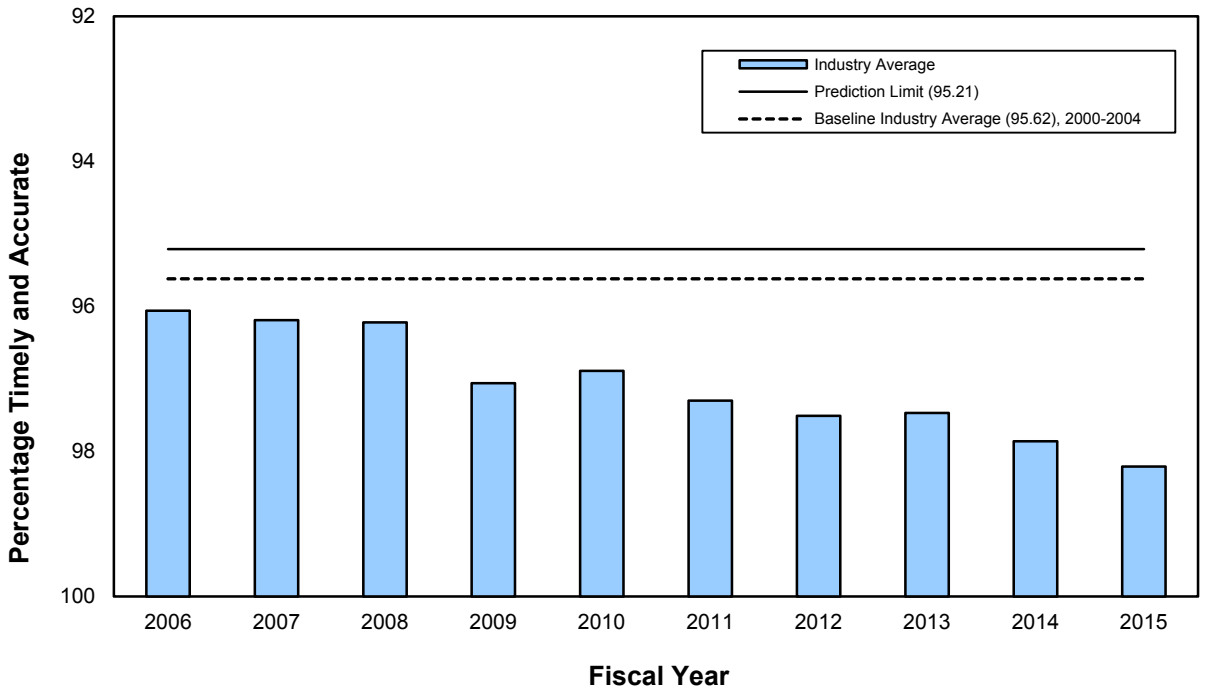


Figure 3. Reactor coolant system leakage

Note that the steam generator tube rupture event at Indian Point Nuclear Generating Unit 2 in 2000 was not included in the short-term data for determining prediction limits in Figure 3. This event was excluded from the development of the prediction limit models because it was considered as an outlier that could overly influence the statistical analysis of the industrywide data. This treatment results in a more conservative prediction limit.



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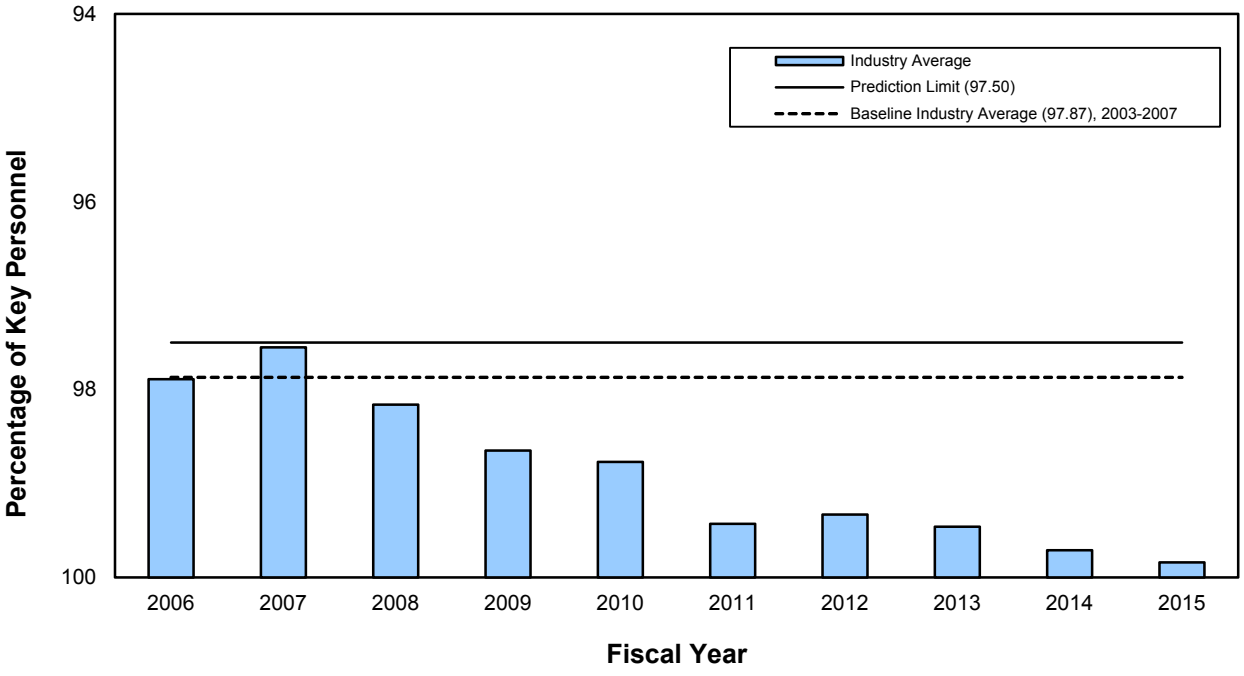

Figure 5. Emergency response organization drill participation

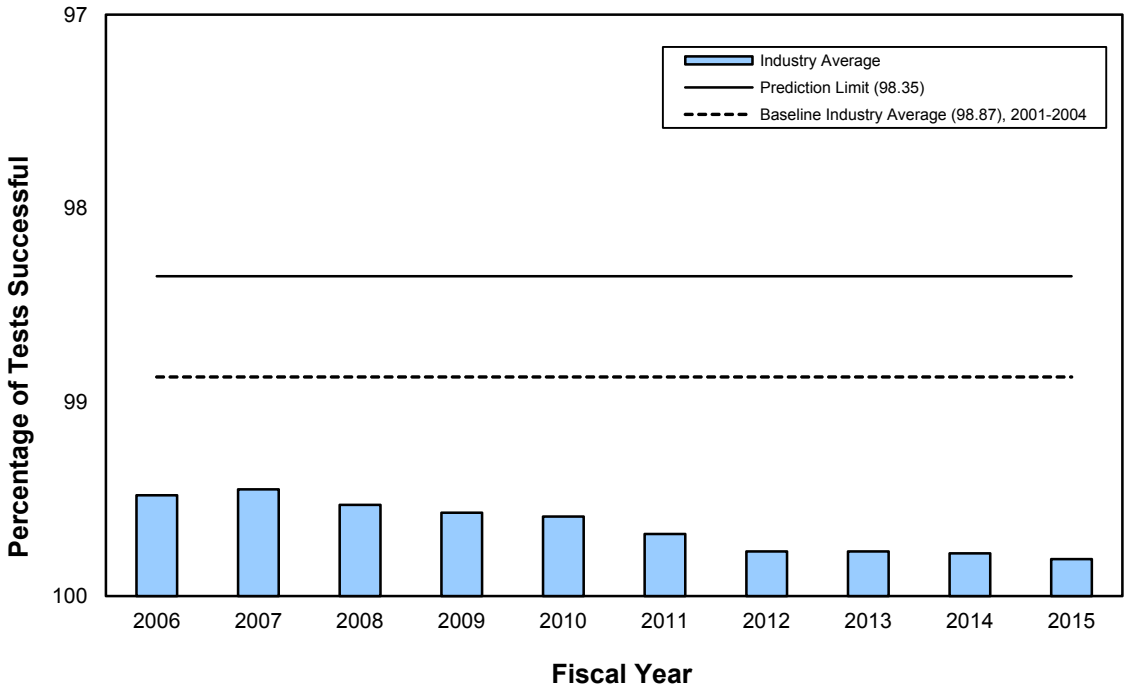

Figure 6. Alert and notification system reliability

SUMMARY OF BASELINE RISK INDEX FOR INITIATING EVENTS: ANNUAL GRAPHS THROUGH FISCAL YEAR 2015

The baseline risk index for initiating events (BRIIE) addresses the initiating event (IE) cornerstone in the U.S. Nuclear Regulatory Commission's (NRC's) Reactor Oversight Process (ROP) for monitoring commercial nuclear power plants. It is based on plant performance for the 10 initiator events listed in the table below.

INITIATOR	ACRONYM	APPLICABLE PLANTS
General transient	TRAN	Both plant types, separately
Loss of condenser heat sink	LOCHS	Both plant types, separately
Loss of main feedwater	LOMFW	Both plant types
Loss of offsite power	LOOP	Both plant types
Loss of vital alternating current bus	LOAC	Both plant types
Loss of vital direct current bus	LODC	Both plant types
Stuck-open safety or relief valve	SORV	Both plant types, separately
Loss of instrument air	LOIA	Both plant types, separately
Very small loss-of-coolant accident	VSLOCA	Both plant types
Steam generator tube rupture	SGTR	Pressurized-water reactors (PWRs) only

The BRIIE program is described in NUREG/CR-6932, "Baseline Risk Index for Initiating Events (BRIIE)," issued June 2007. The BRIIE considers individual IEs and evaluates performance based on statistical prediction limits. This evaluation is for the ongoing monitoring and early detection of possible industry-level deficiencies. Because four of the initiators have separate data for each plant type, there are 14 IE frequency graphs.

The units for the IE frequency graphs are event counts for a fiscal year divided by the industry critical time for the year. The graphs also show the average frequency for an established "baseline period" and 95-percent prediction limits for a future year if occurrences continue at the same rate as in the baseline period. If industry data shift as time progresses, the baseline periods used to determine the prediction limits might no longer be relevant. The periods originally were developed to describe, roughly, calendar years 1998–2002.

The prediction limits depend on the expected critical years of reactor operation in the upcoming year and the baseline occurrence rate for each indicator. A rate can exceed a limit by having more events than expected or by having the same number of events and less critical time than expected. In recent years, U.S. nuclear power plant availability has been about 90 percent at the industry level. This figure enters into the calculations that determine the bounds on the number of events that might be expected.

None of the fiscal year 2015 occurrence rates exceeded their prediction limits.

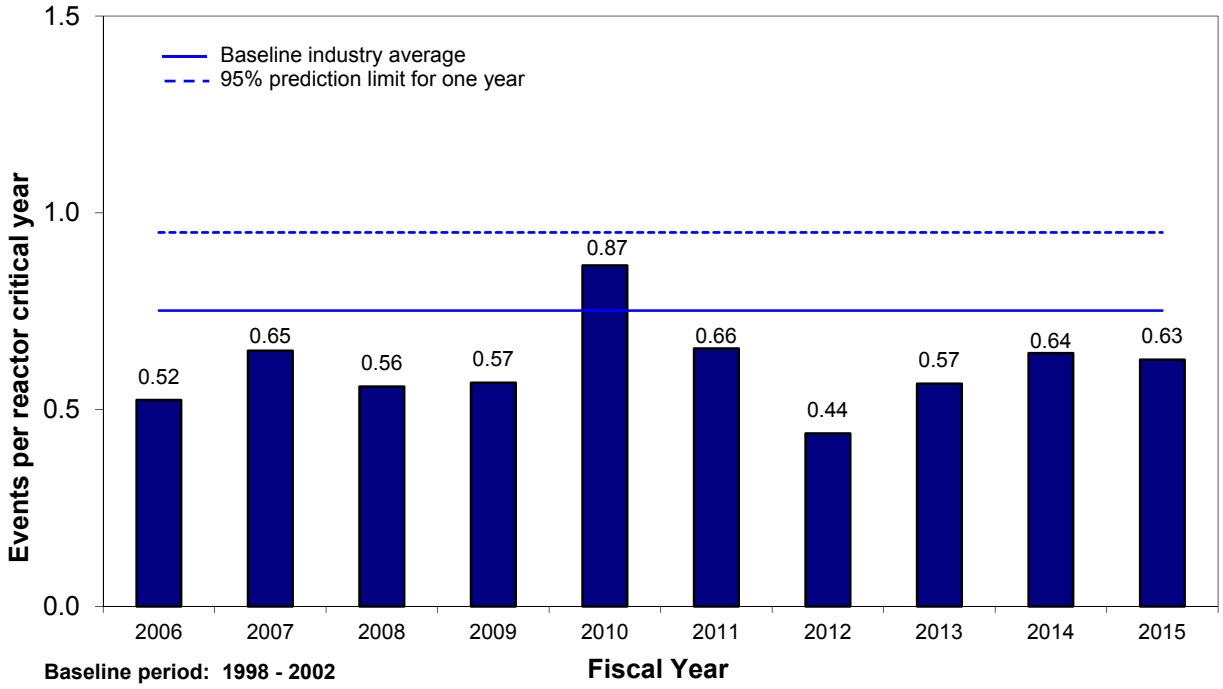

Figure 1. Pressurized-water reactor (PWR) general transients

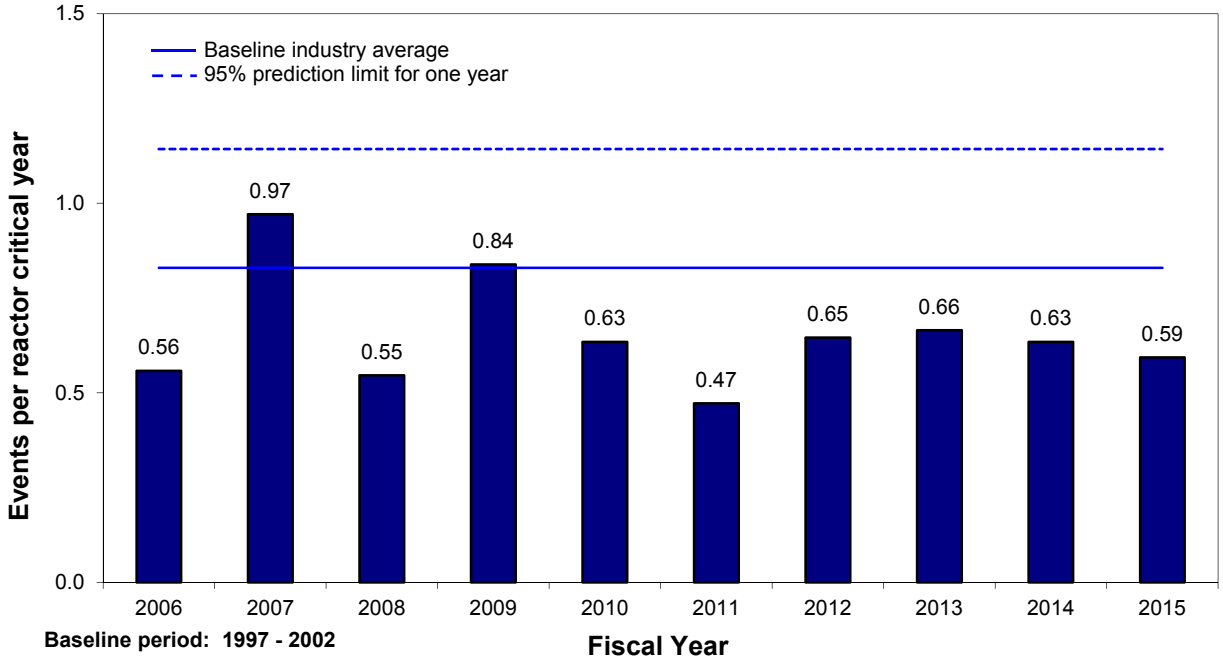

Figure 2. Boiling-water reactor (BWR) general transients

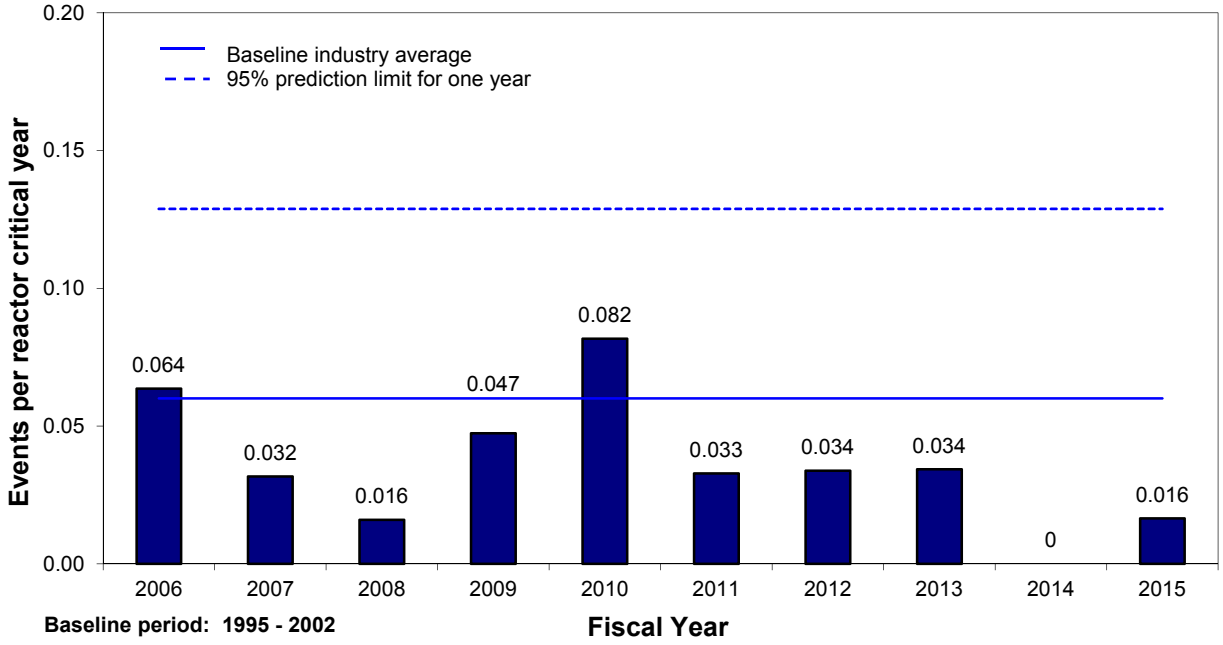

Figure 3. PWR loss of condenser heat sink

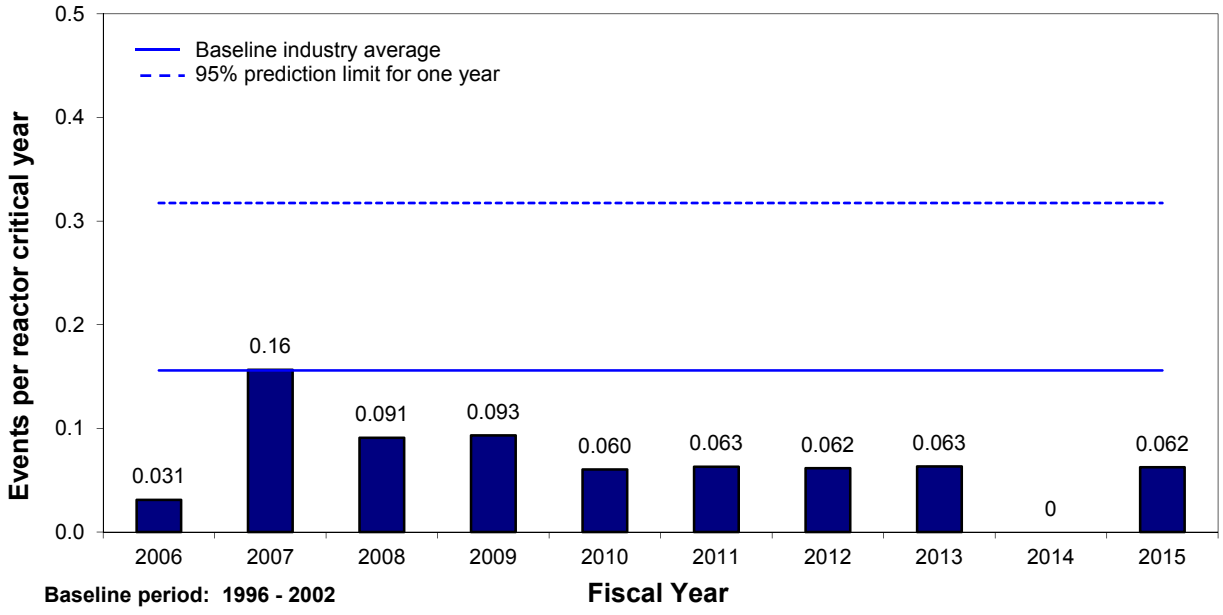

Figure 4. BWR loss of condenser heat sink

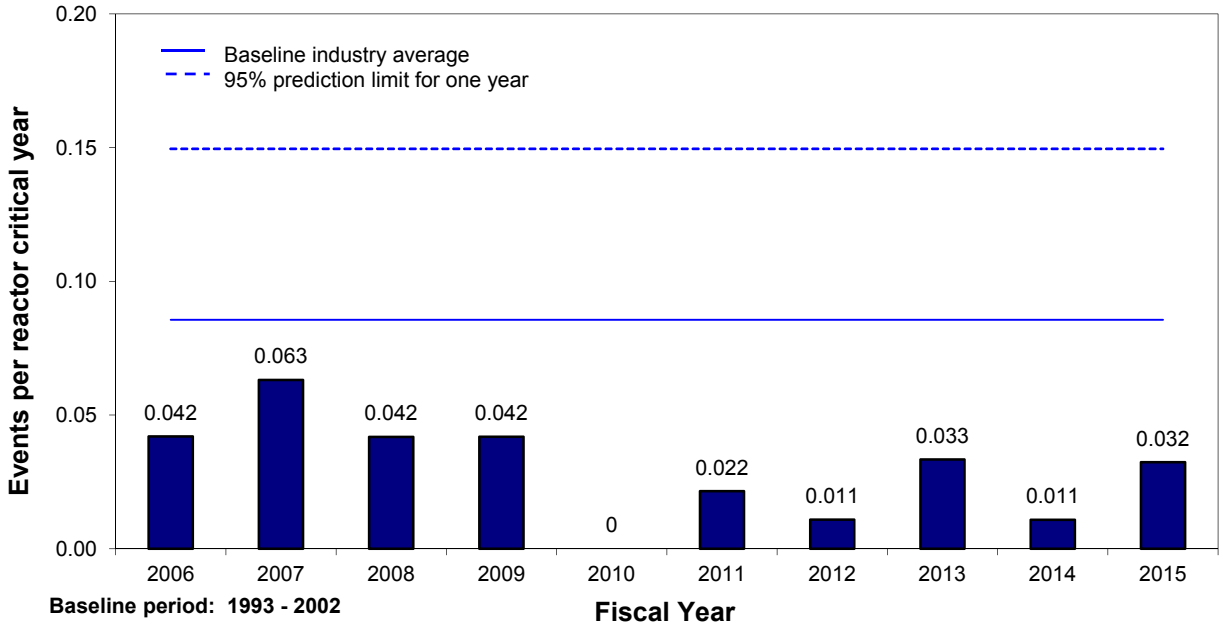

Figure 5. Loss of main feedwater

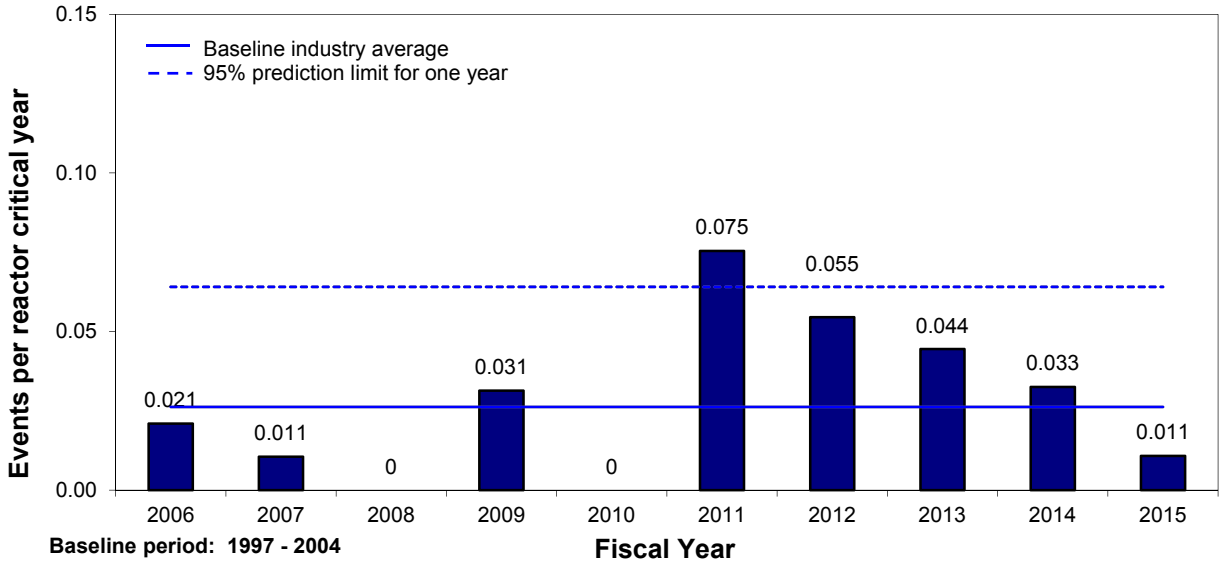

Figure 6. Loss of offsite power

The prediction limit for loss of offsite power was calculated under the assumption that the eight at-power events that occurred during the 2003 blackout were a single event. This treatment results in a more conservative prediction limit.

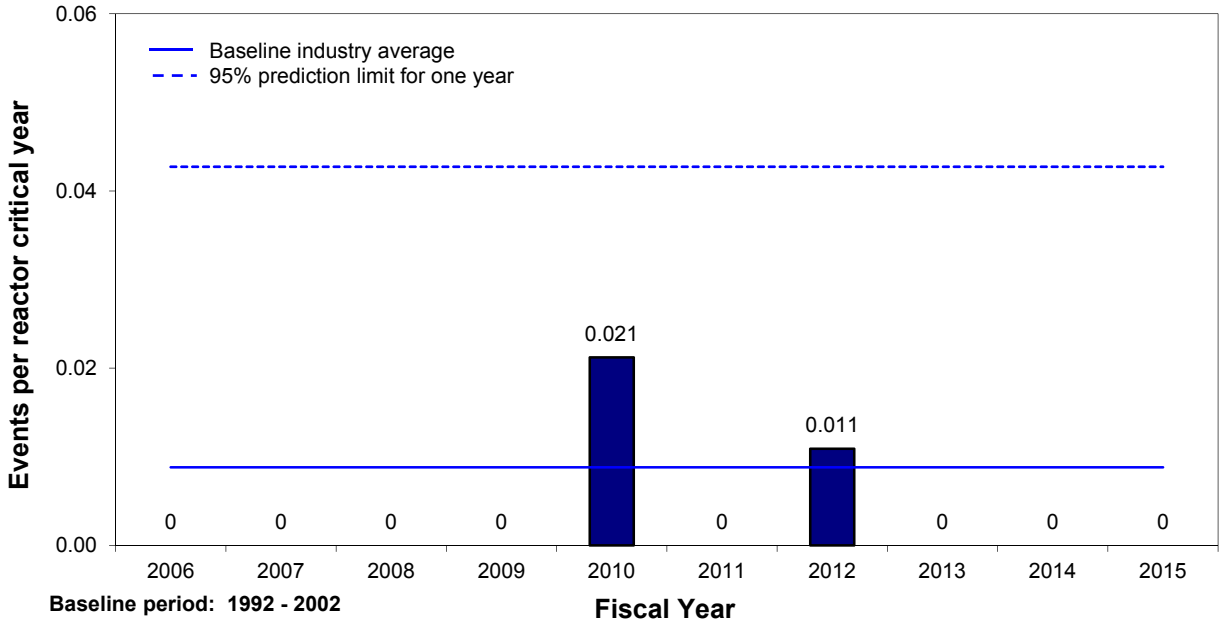

Figure 7. Loss of vital alternating-current bus

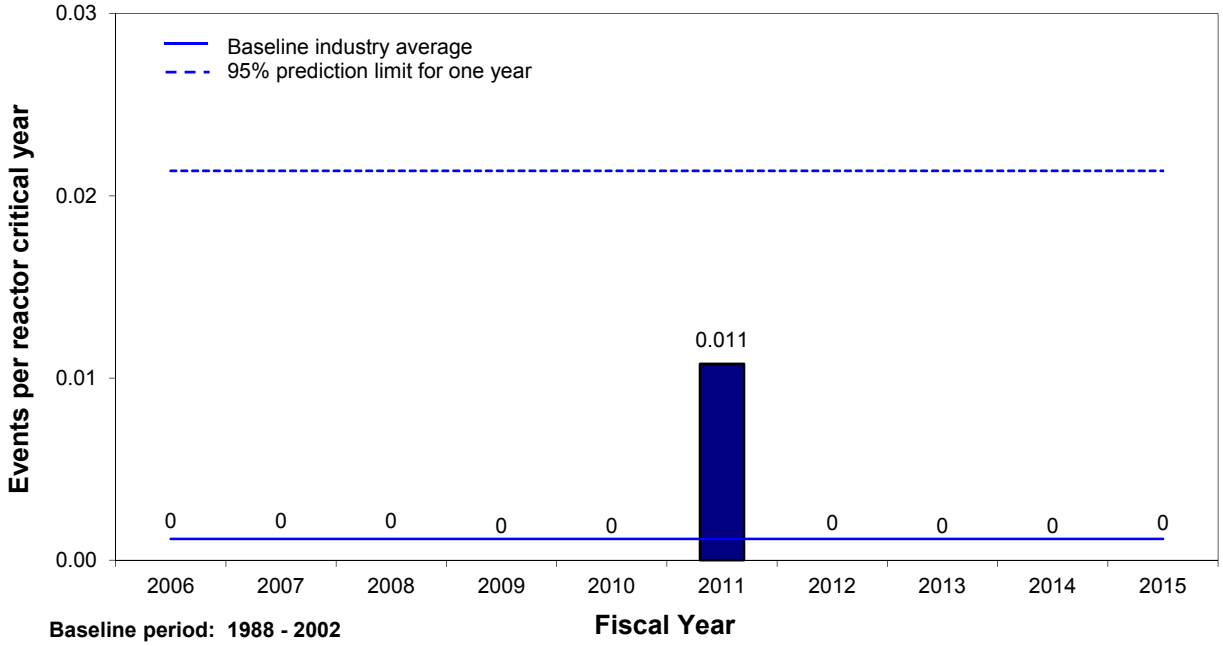

Figure 8. Loss of vital direct-current bus

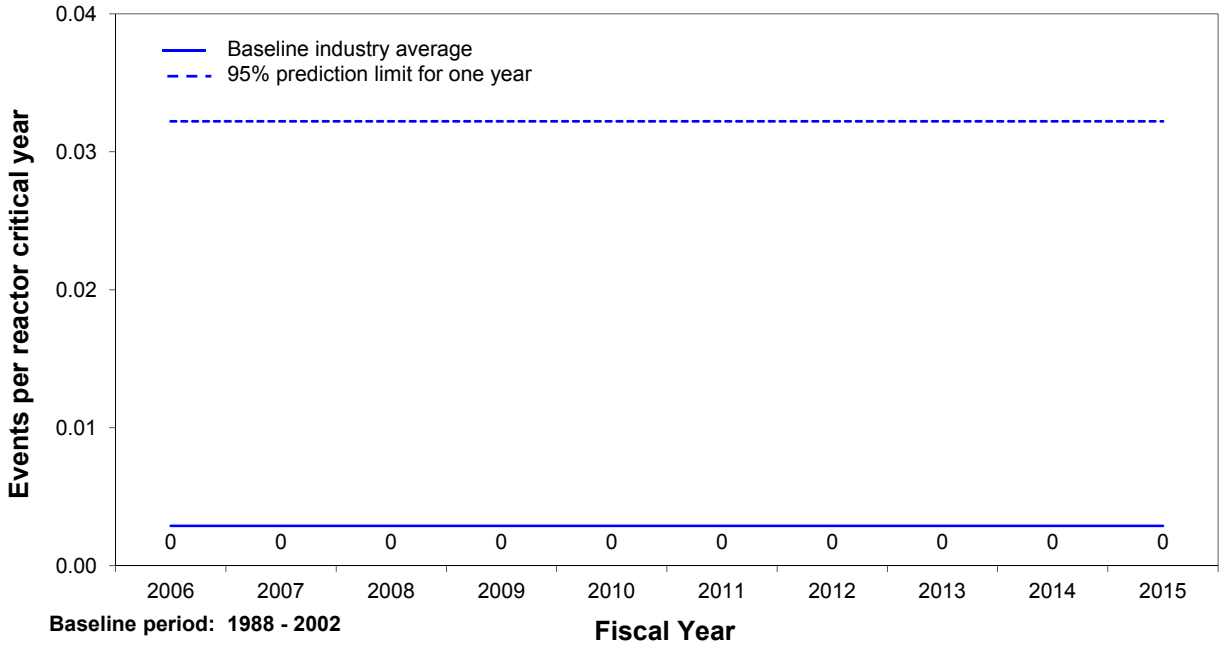

Figure 9. PWR stuck-open safety or relief valve

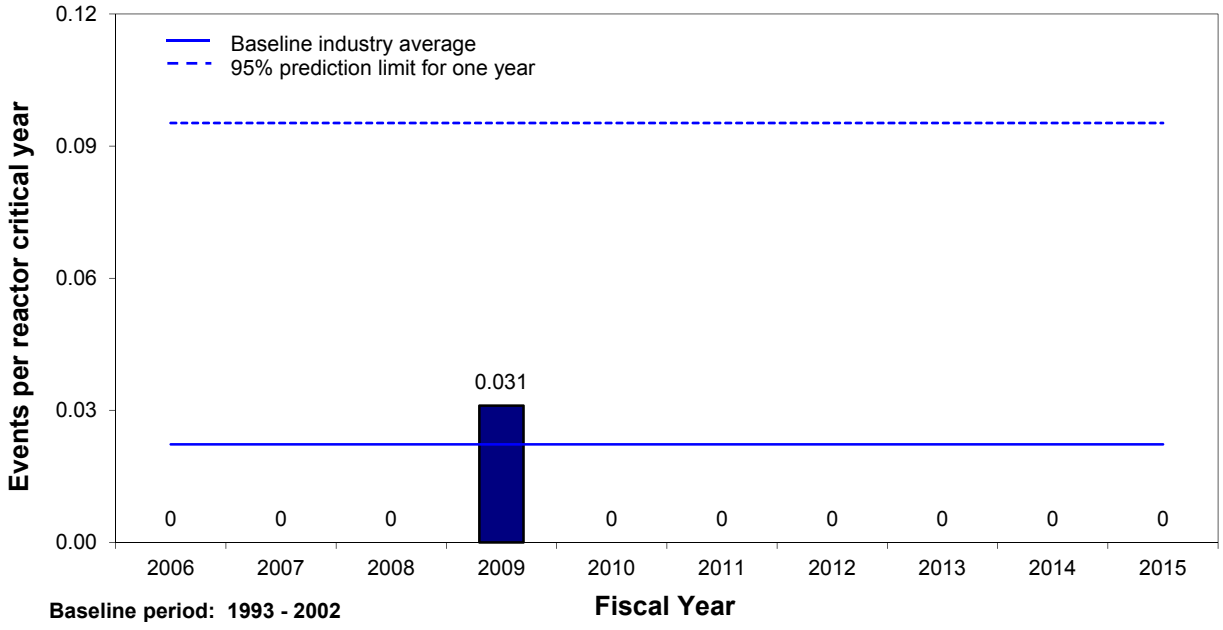

Figure 10. BWR stuck-open safety or relief valve

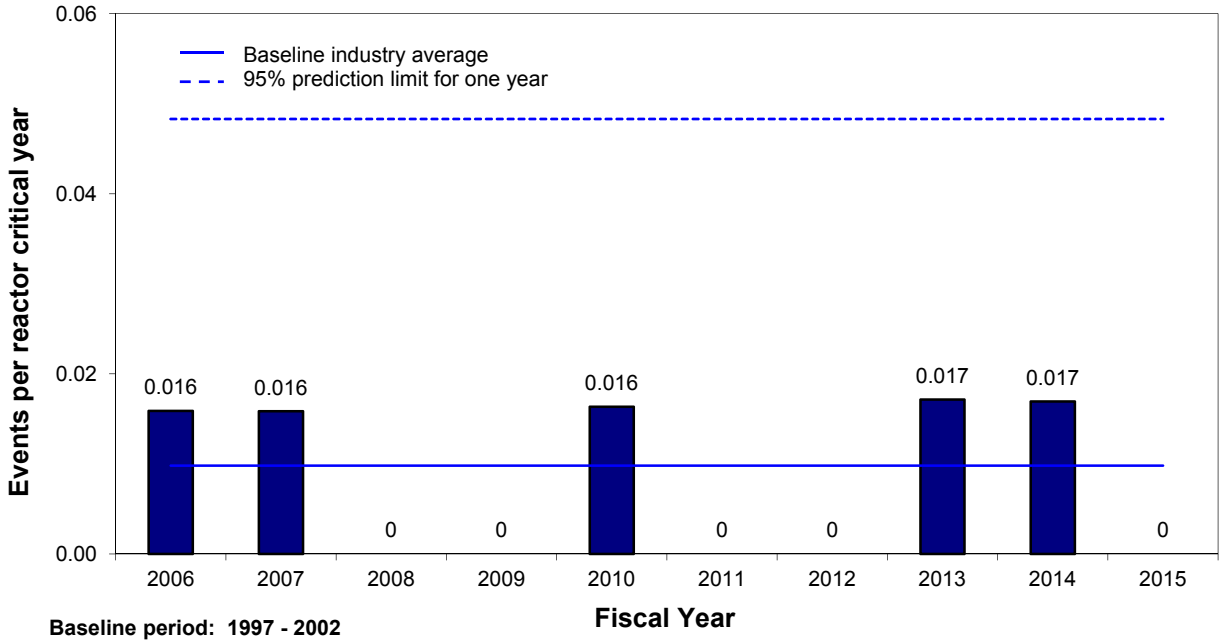

Figure 11. PWR loss of instrument air

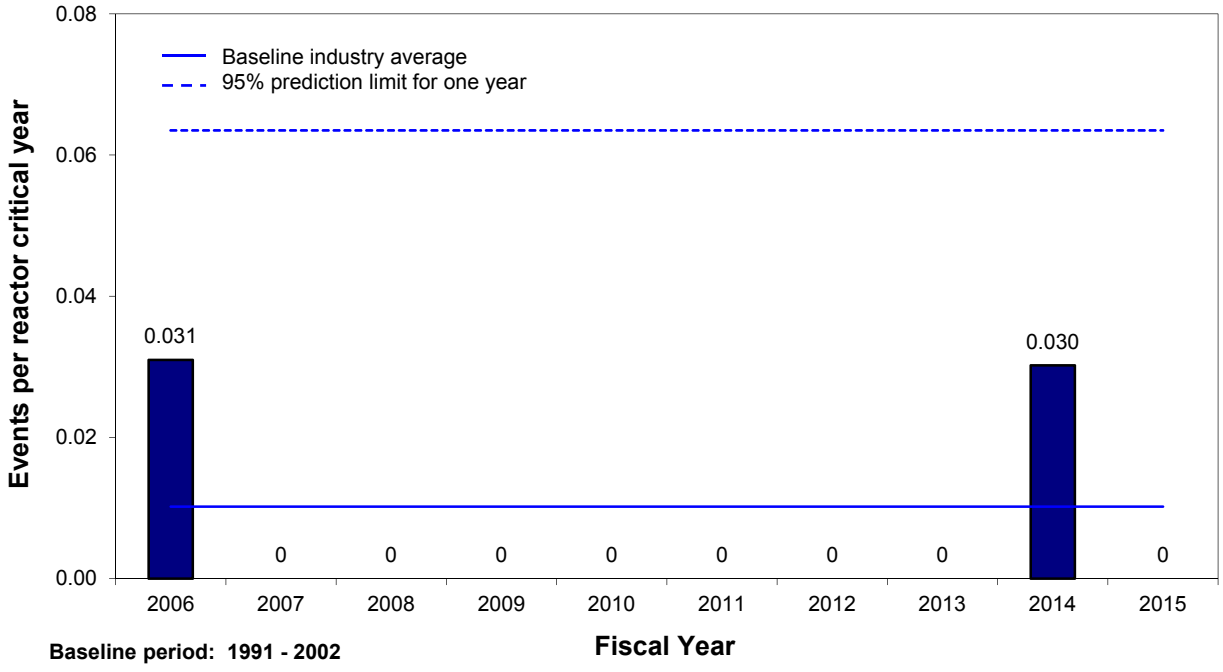

Figure 12. BWR loss of instrument air

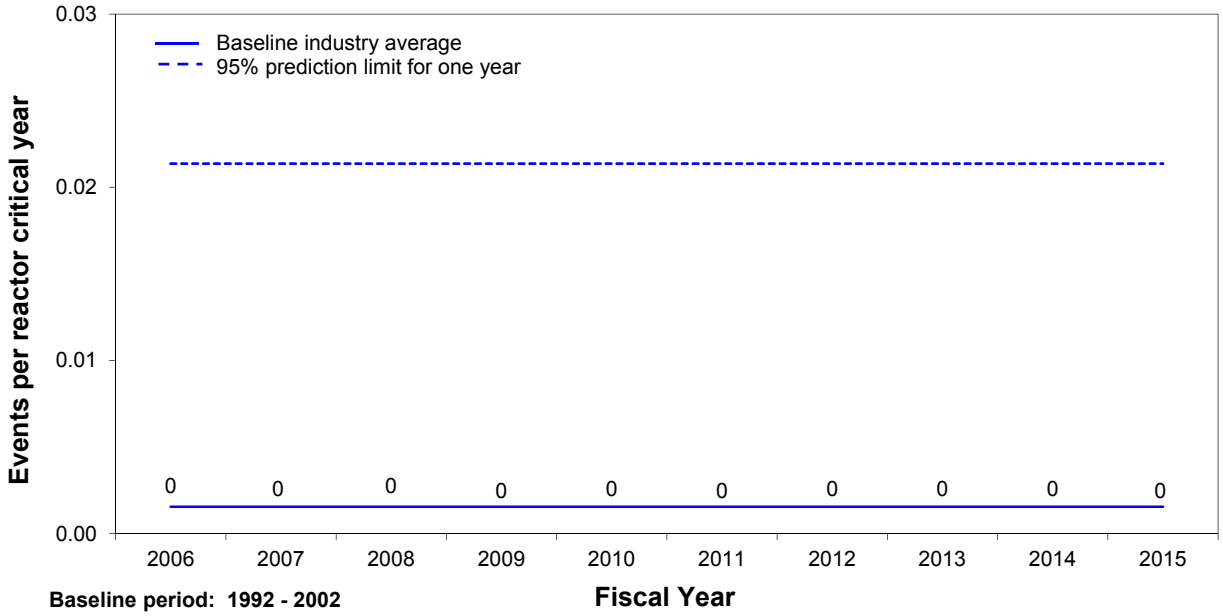

Figure 13. Very small loss-of-coolant accident

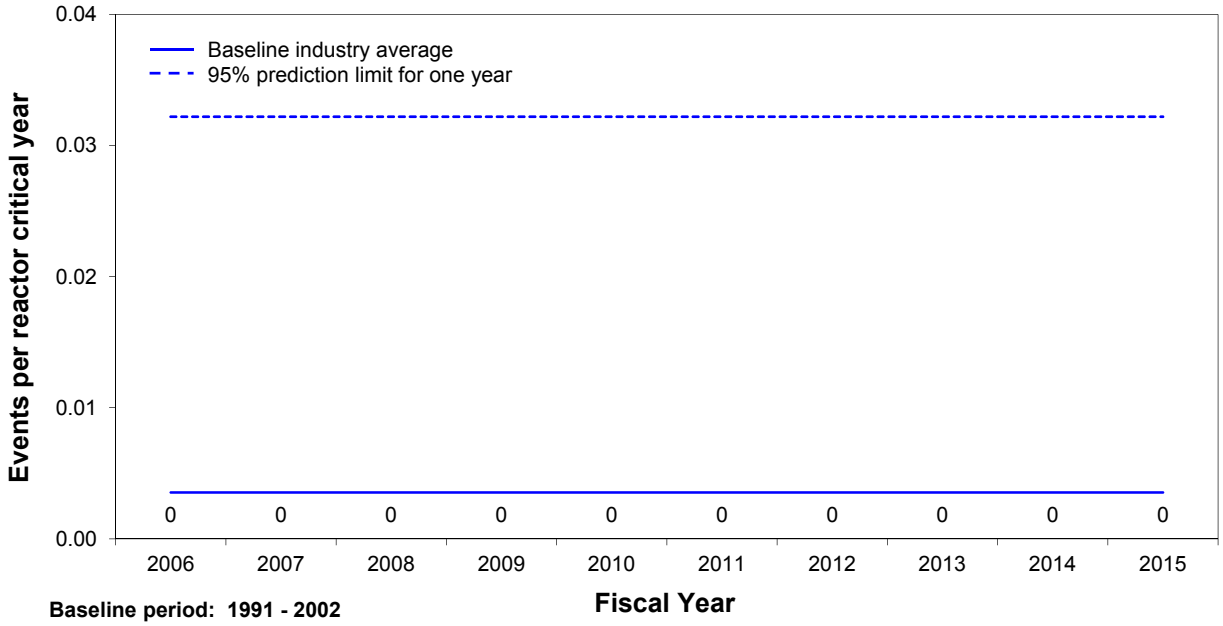

Figure 14. PWR steam generator tube rupture

FISCAL YEAR 2015 RESULTS FOR RECENTLY REPLACED INDUSTRY TREND INDICATORS

To provide continuity while transitioning to the use of Reactor Oversight Process performance indicator data for the Industry Trends Program (ITP), the staff of the U.S. Nuclear Regulatory Commission also evaluated the recently replaced ITP indicators. These indicators (with the exception of Accident Sequence Precursors) were each evaluated for both long-term statistically significant trends and short-term comparison against the noted baseline industry average and pre-established prediction limit. As noted in the main body of the paper, the staff identified a statistically significant adverse trend for the Safety System Failure indicator from fiscal year (FY) 2006 to FY 2015 caused by outliers in the data and does not require any generic actions. None of the indicators exceeded the short-term prediction limit in FY 2015. The previous revision of IMC 0313, "Industry Trends Program," dated May 29, 2008 (ADAMS Accession No. ML080860540), contains definitions and details on these ITP indicators that have recently been replaced.

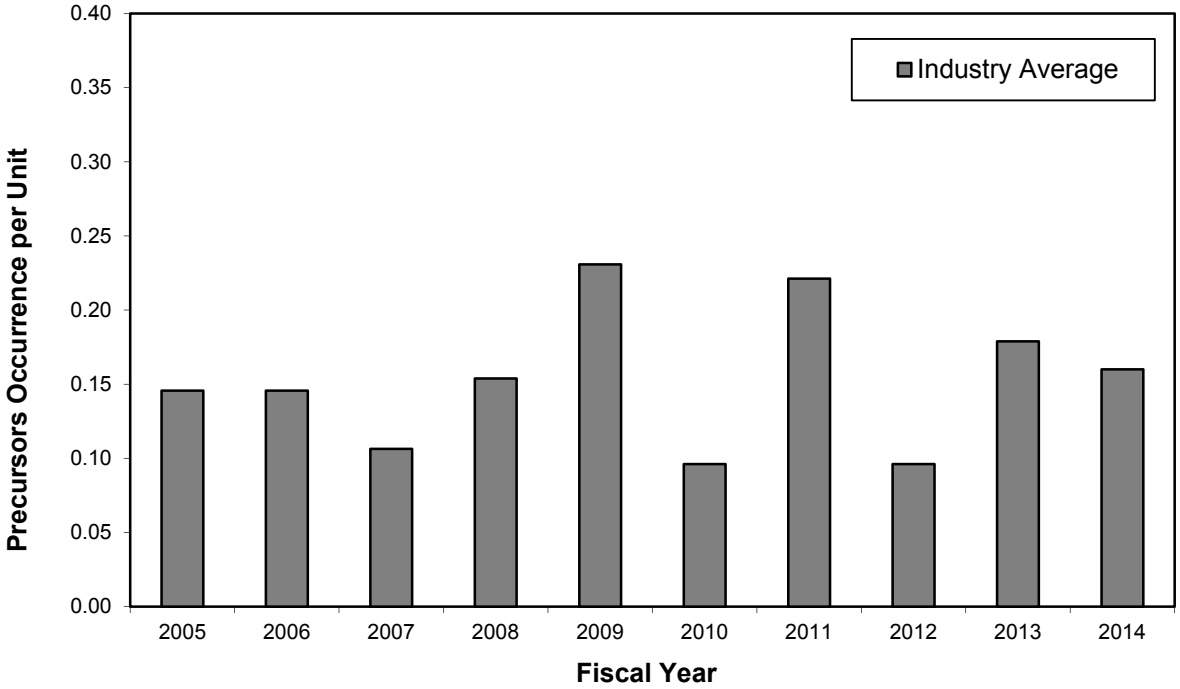

Figure 1. Accident sequence precursors (FY 2005-2014)

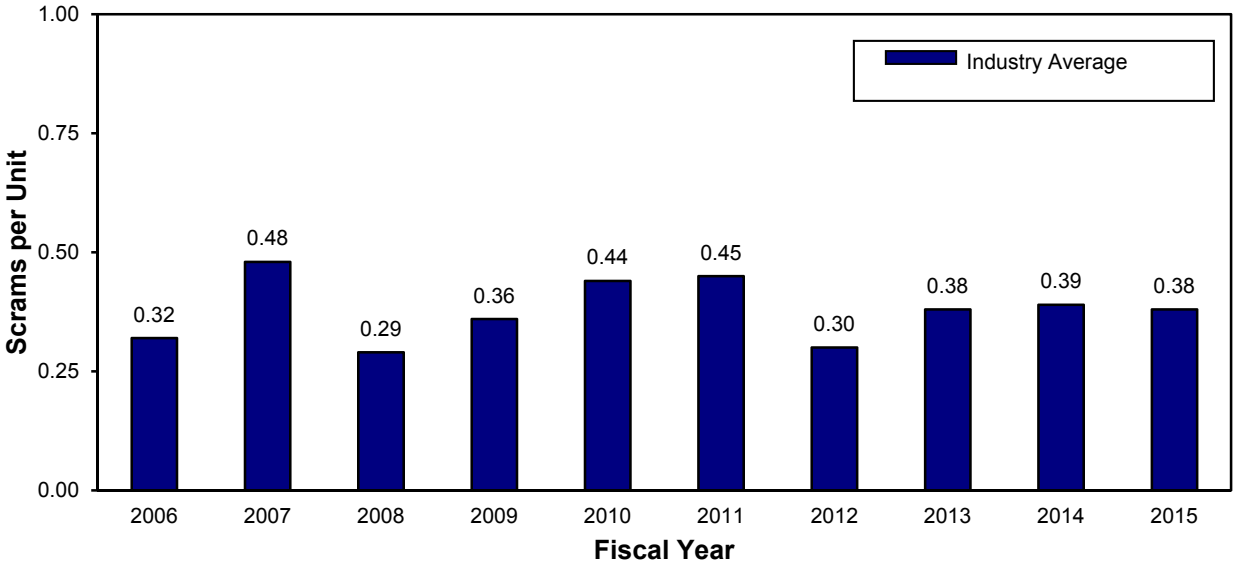

Figure 2. Automatic scrams while critical long-term results

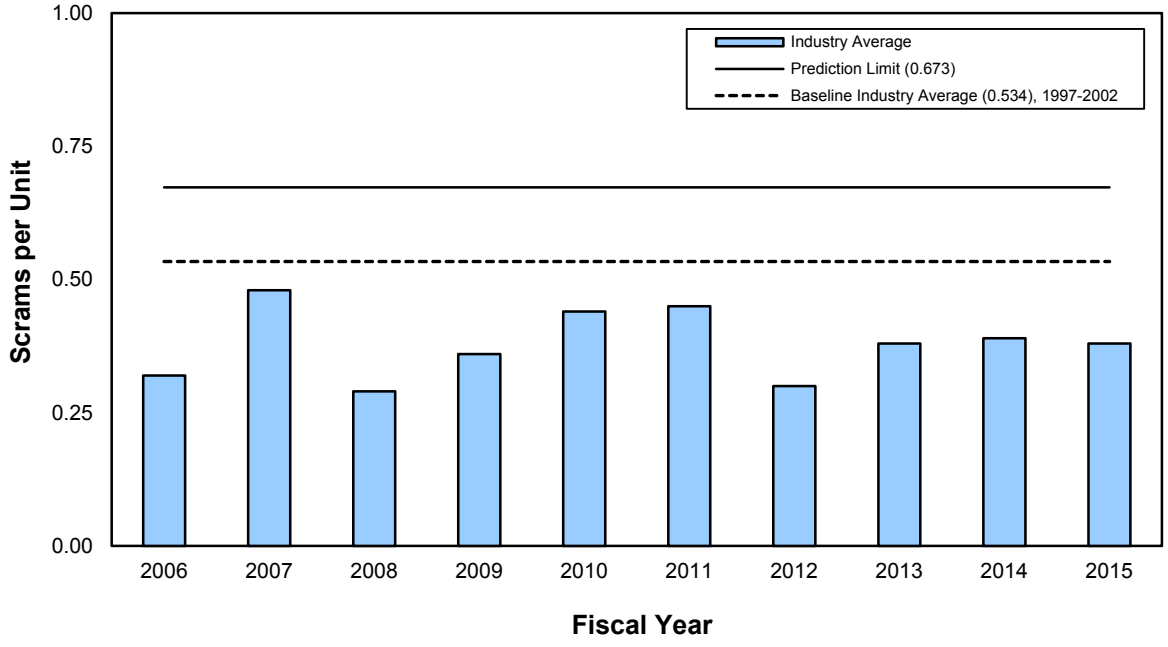

Figure 3. Automatic scrams while critical short-term results

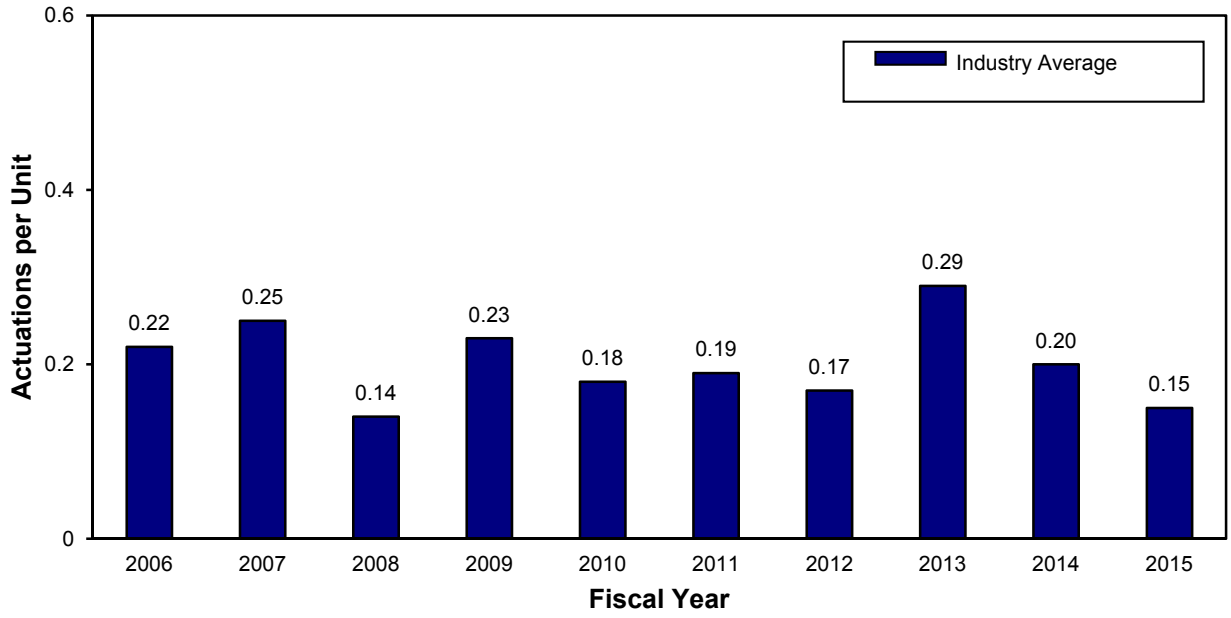

Figure 4. Safety-system actuations long-term results

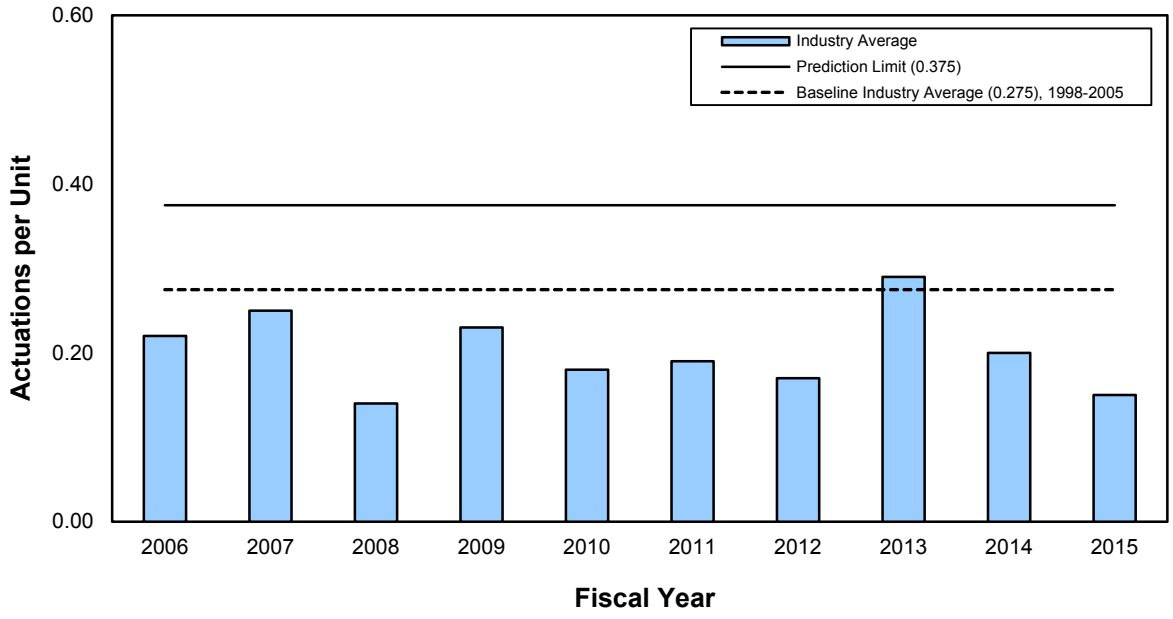

Figure 5. Safety-system actuations short-term results

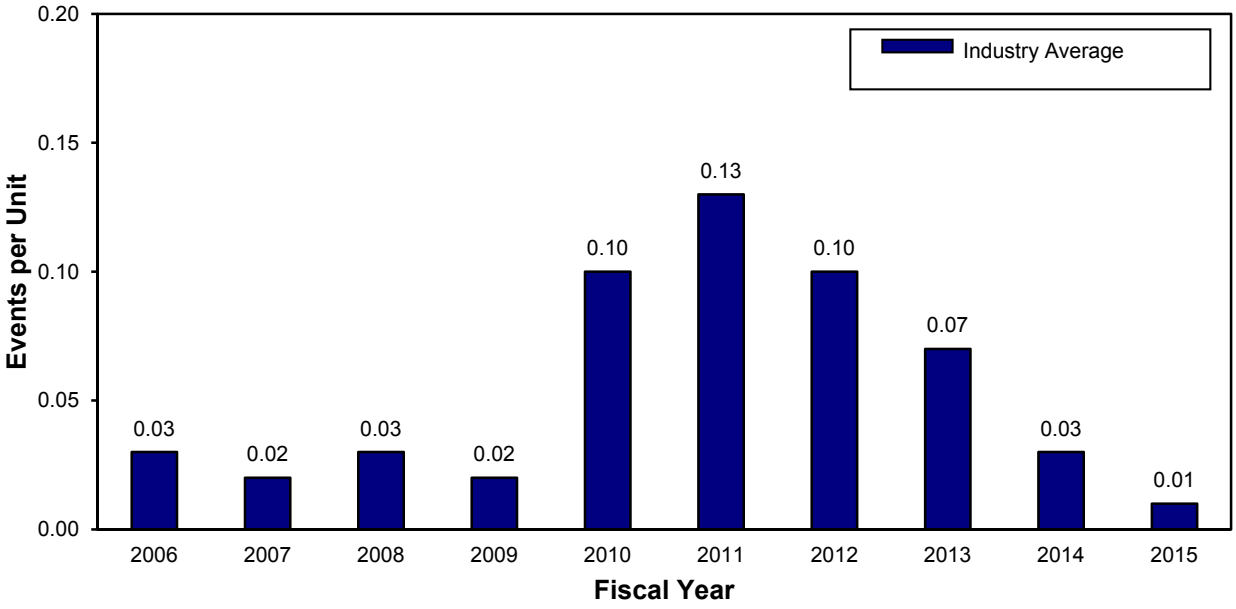

Figure 6. Significant events long-term results

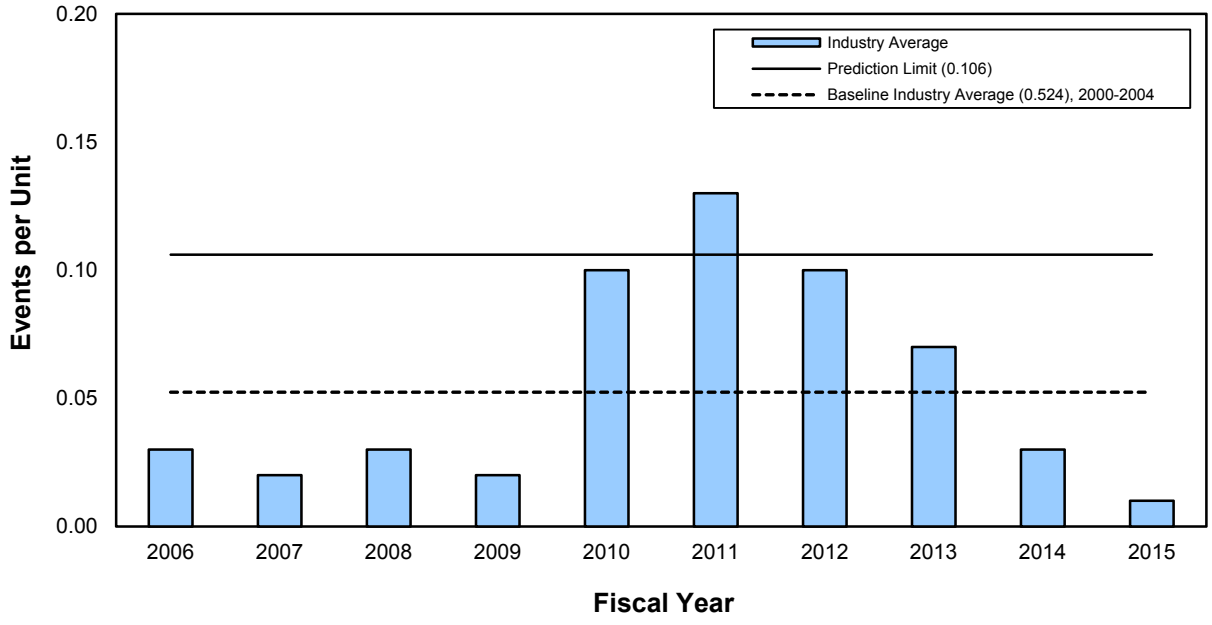

Figure 7. Significant events short-term results

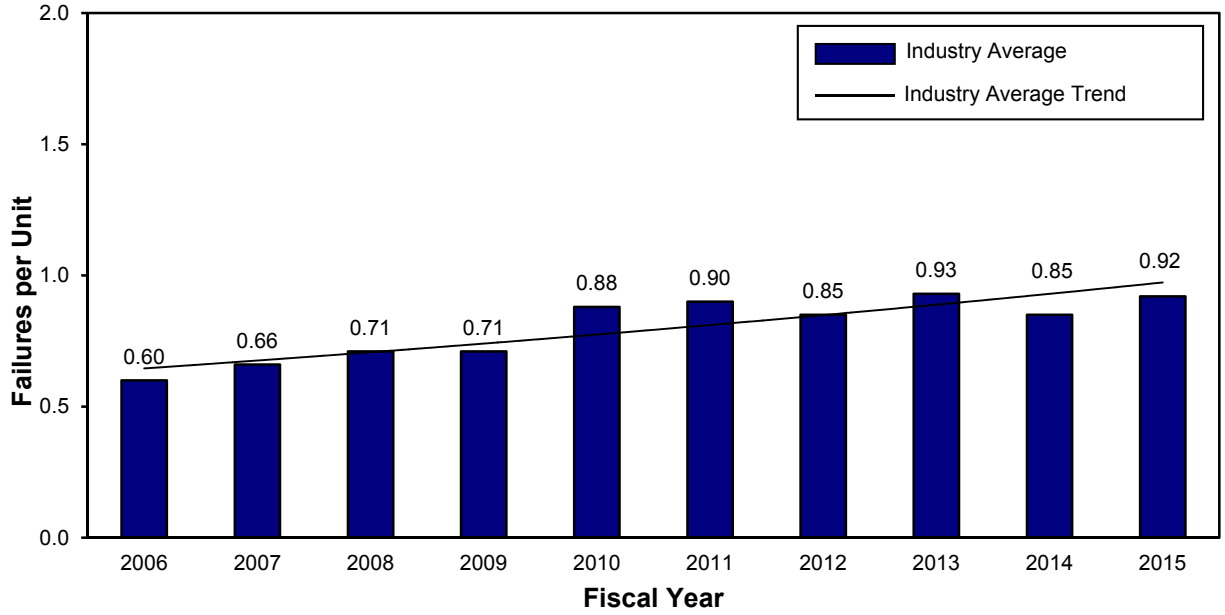

Figure 8. Safety-system failures long-term results

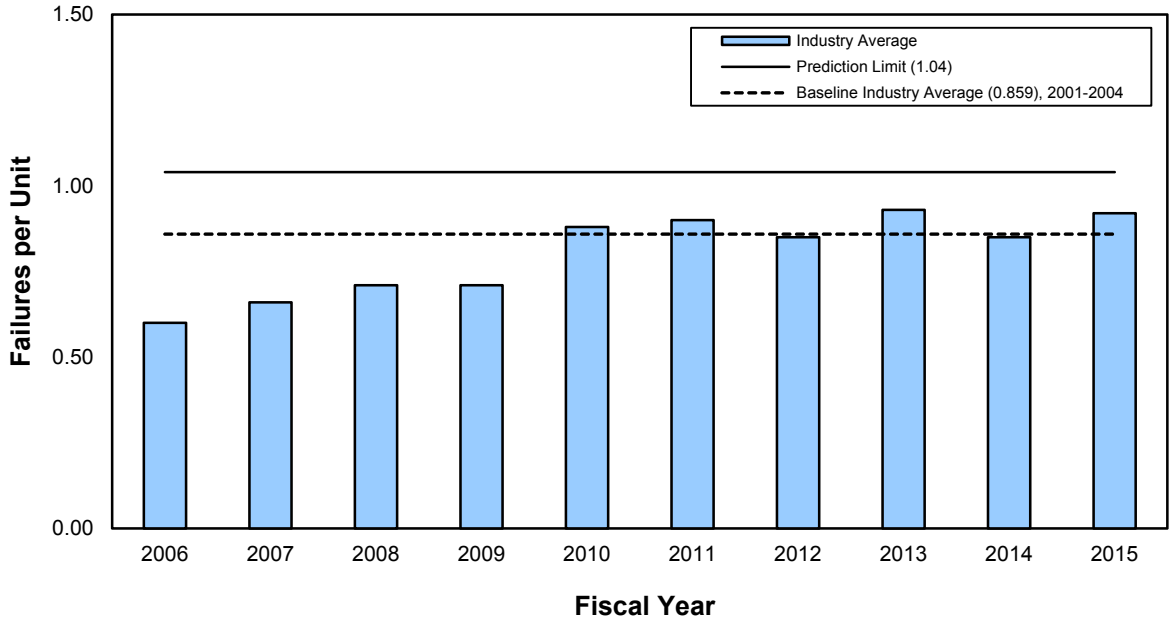

Figure 9. Safety-system failures short-term results

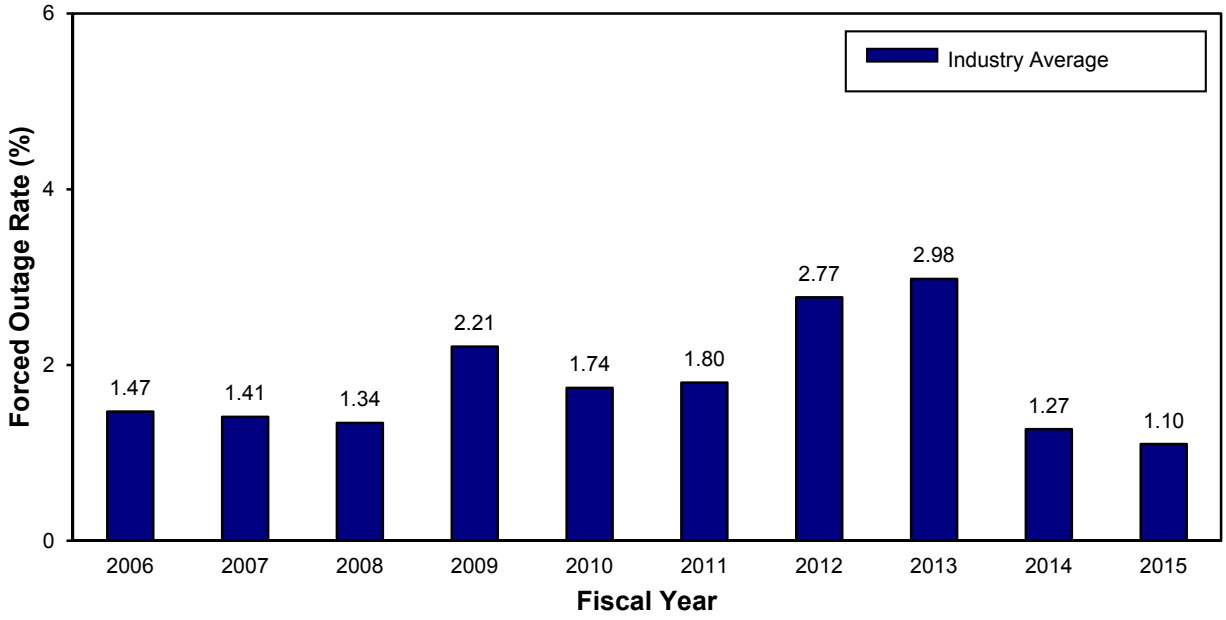

Figure 10. Forced outage rate long-term results

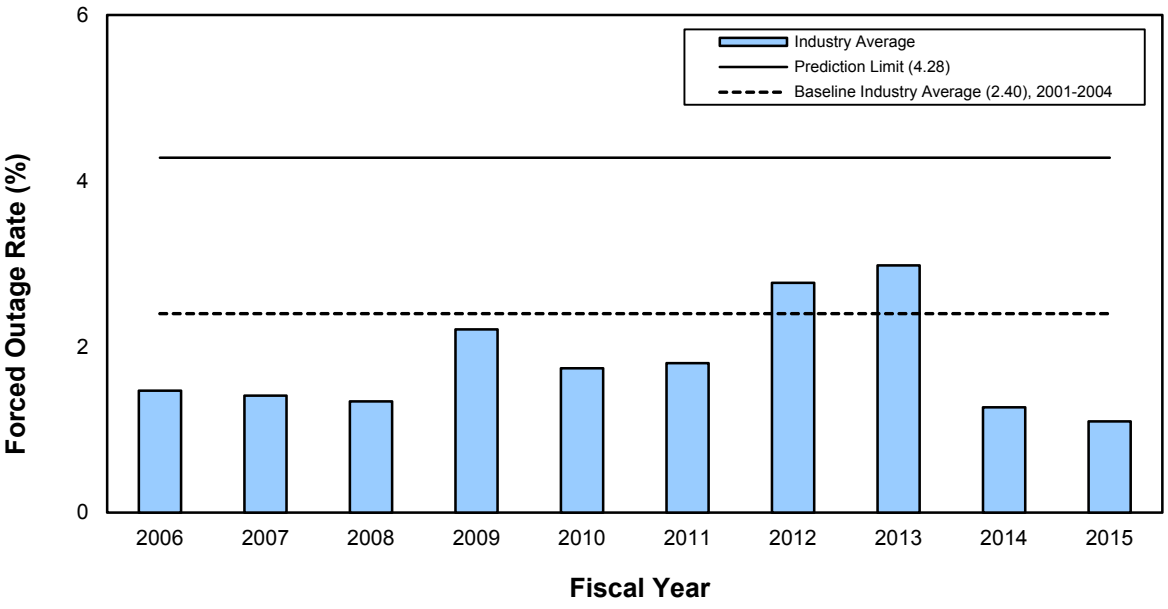

Figure 11. Forced outage rate short-term results

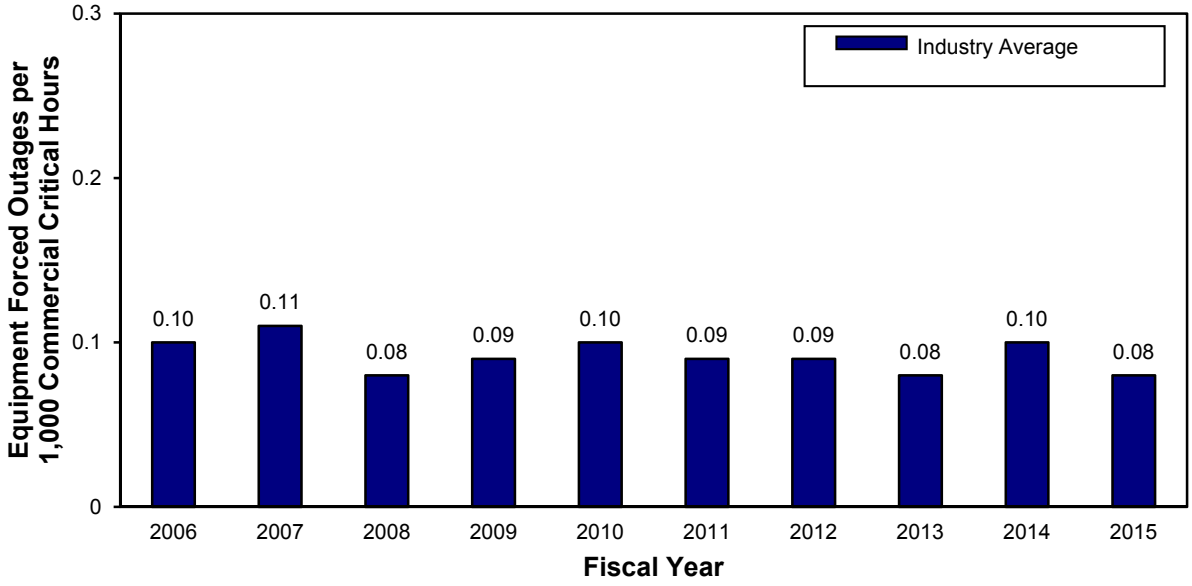

Figure 12. Equipment forced outages long-term results

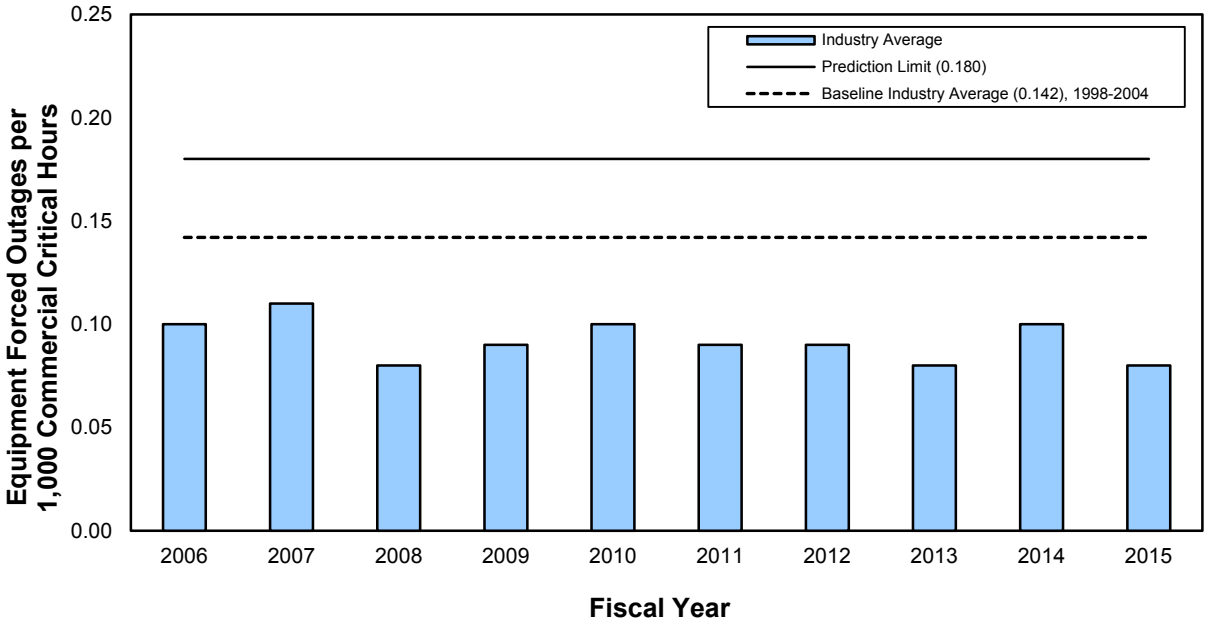

Figure 13. Equipment forced outages short-term results

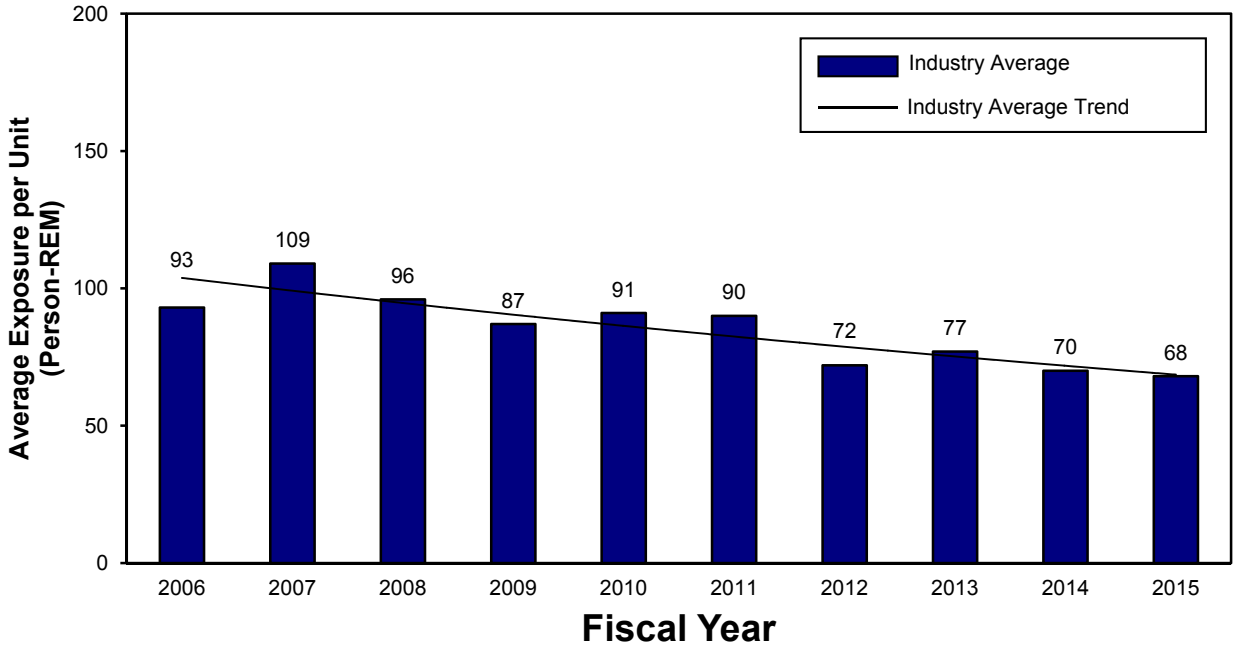

Figure 14. Collective radiation exposure long-term results

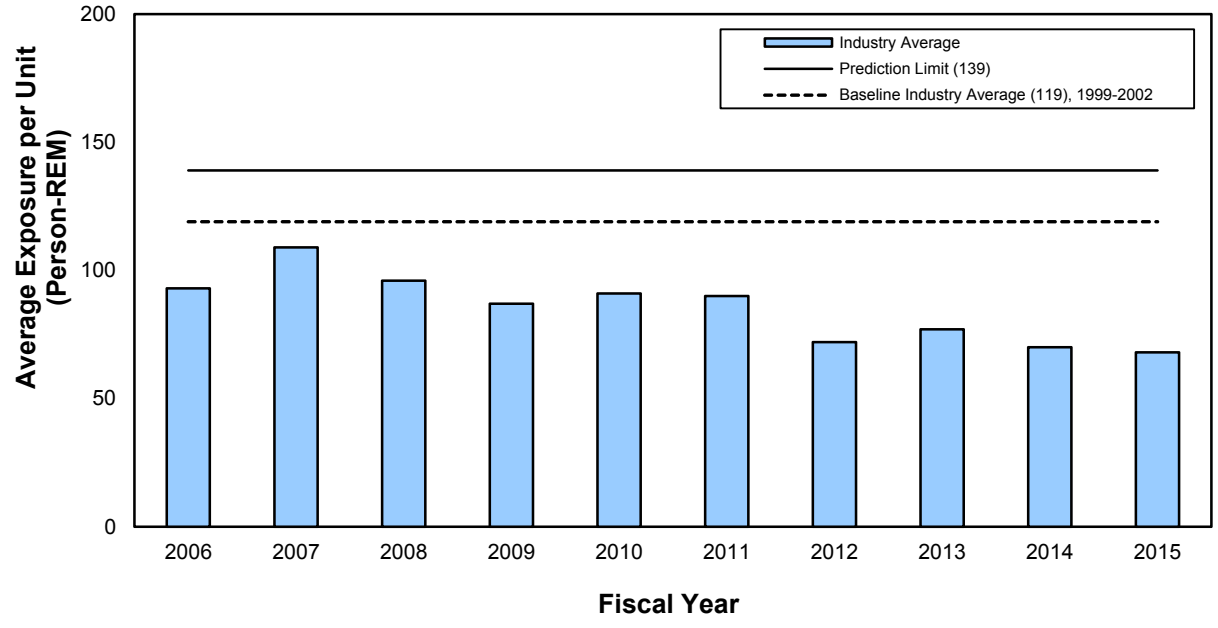

Figure 15. Collective radiation exposure short-term results