Enhanced Component Performance Study

Turbine-Driven Pumps

1998–2008

1 INTRODUCTION

This report presents a performance evaluation of turbine-driven pumps (TDPs) at U.S. commercial nuclear power plants. This report does not estimate values for use in probabilistic risk assessments (PRAs), but does evaluate component performance over time. Reference 1 (NUREG/CR-6928) reports TDP unreliability estimates using Equipment Performance and Information Exchange (EPIX) data from 1998–2002 and maintenance unavailability (UA) performance data using MSPI Basis Document data from 2002–2004 for use in PRAs.

The trend evaluations in this study are based on the operating experience failure reports from fiscal year (FY) 1998 through FY 2008 as reported in EPIX. The TDP failure modes considered are for standby systems: failure-to-start (FTS), failure-to-run ≤ 1 hour (FTR≤1H), failure-to-run > 1 hour (FTR>1H), and for normally running systems: FTS and failure-to-run (FTR). TDP train maintenance unavailability data for trending are from the same time period, as reported in the Reactor Oversight Program (ROP) and EPIX. In addition to the presentation of the component failure mode data and the UA data, an 8-hour unreliability is calculated and trended.

Previously, the study relied on operating experience obtained from licensee event reports, Nuclear Plant Reliability Data System (NPRDS), and EPIX. The EPIX database (which includes as a subset the Mitigating Systems Performance Index (MSPI) designated devices) has matured to the point where component availability and reliability can be estimated with a higher degree of assurance of accuracy. In addition, the population of data is much larger than the population used in the previous study.

The objective of the effort for the updated component performance studies is to obtain annual performance trends of failure rates and probabilities. An overview of the trending methods, glossary of terms, and abbreviations can be found in the Overview and Reference document on the Reactor Operational Experience Results and Databases web page.

The objective of the enhanced component performance study is to present an analysis of factors that could influence the system and component trends in addition to annual performance trends of failure rates and probabilities. The factors analyzed for the TDP component are the differences in failures between total demands and actual unplanned (ESF) demands (Section 6.3). Statistical analyses of the differences are performed and results showing whether pooling is acceptable across these factors are shown. In addition, engineering analyses were performed with respect to time period and failure mode (Section 6.4). The factors analyzed are: sub-component, failure cause, recovery, and detection method.

2 SUMMARY OF FINDINGS

The results of this study are summarized in this section. Of particular interest is the existence of any statistically significant[1] increasing trends. In this update, two highly statistically significant increasing trends were identified in the TDP results.

- Standby systems, industry-wide TDP FTR>1H trend. (see Figure 3)
- Standby systems, industry-wide TDP unreliability trend (8-hour mission). (see Figure 7)
- Frequency (events per reactor year) of FTR>1H events, standby TDPs. (see Figure 14)

The trends shown in Figure 3, Figure 7 and Figure 14 are the result of the same increase over time of TDP FTR>1H events. There were a total of 28 FTR>1H events in the standby TDPs and all but fifteen of those failures were in the AFW TDPs (see Table 6). Twelve of the thirteen AFW events occurred from FY 2004 to FY 2008. In addition to the increased evidence of TDP FTR>1H failures, the run hours for the standby systems decreased during these same years.

Statistically significant decreasing trends were identified in the TDP results for the following:

- Frequency (events per reactor year) of start demands, standby TDPs. (see Figure 9)
- Standby TDP run hours per reactor critical year of run ≤ 1H hours. (see Figure 10)
- Standby TDP run hours per reactor critical year. (see Figure 11)

An ongoing concern in the industry is whether industry data adequately represent standby component performance during unplanned (ESF) demands. Section 6.3 shows the results of the consistency check between industry data and ESF detected failure data. Standby TDP FTS failures are consistent with the industry data. Standby TDP FTR≤1H and FTR>1H failures and the Total TDP unreliability for an 8-hour mission are not consistent with the industry data and show a statistically significant higher rate of occurrence.

3 FAILURE PROBABILITIES AND FAILURE RATES

3.1 Overview

The industry-wide failure probabilities and failure rates of TDPs have been calculated from the operating experience for FTS, FTR≤1H, FTR>1H, and FTR. The TDP data set obtained from EPIX includes TDPs in the systems listed in Table 1. Table 2 shows industry-wide failure probability and failure rate results for the TDP from Reference 1.

The TDPs are assumed to operate both when the reactor is critical and during shutdown periods with sufficient steam pressure. The number of TDPs in operation is assumed to be constant throughout the study period. All demand types are considered—testing, non-testing, and, as applicable, emergency safeguard feature (ESF) demands.

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[1] Statistically significant is defined in terms of the ‘p-value.’ A p-value is a probability indicating whether to accept or reject the null hypothesis that there is no trend in the data. P-values of less than or equal to 0.05 indicate that we are 95% confident that there is a trend in the data (reject the null hypothesis of no trend.) By convention, we use the "Michelin Guide" scale: p-value < 0.05 (statistically significant), p-value < 0.01 (highly statistically significant); p-value < 0.001 (extremely statistically significant).

Table 1. TDP systems.

System	Description	Standby	Normally Running
AFW	Auxiliary feedwater	70	
HPCI	High pressure coolant injection	25	
MFW	Main feedwater		58
RCIC	Reactor core isolation cooling	31	
	Total	126	58

Table 2. Industry-wide distributions of *p* (failure probability) and λ (hourly rate) for TDPs.

Operation	Failure Mode	5%	Median	Mean	95%	Distribution		
						Type	α	β
Standby	FTS	7.0E-06	2.5E-03	7.0E-03	3.0E-02	Beta	0.40	5.71E+01
	FTR≤1H	7.0E-05	1.5E-03	2.5E-03	8.0E-03	Gamma	0.80	3.20E+02
	FTR>1H	3.0E-07	3.0E-05	7.0E-05	2.5E-04	Gamma	0.50	7.14E+03
Running/	FTS	1.5E-03	1.5E-02	2.0E-02	6.0E-02	Beta	1.20	6.00E+01
Alternating	FTR	1.5E-06	5.0E-06	6.0E-06	1.2E-05	Gamma	3.00	5.00E+05

3.2 TDP Failure Probability and Failure Rate Trends

The trends are shown for industry standby (Stby) and for industry normally running (NR) results.

Trends in the standby TDP failure probabilities and failure rates are shown in Figure 1 to Figure 3. The data for the trend plots are contained in Table 9 to Table 11. The standby systems from Table 1 are trended together for each failure mode. Trends in the failure probabilities and failure rates for normally operating TDPs are shown in Figure 4 and Figure 5. The data for the trend plots are contained in Table 12 and Table 13.

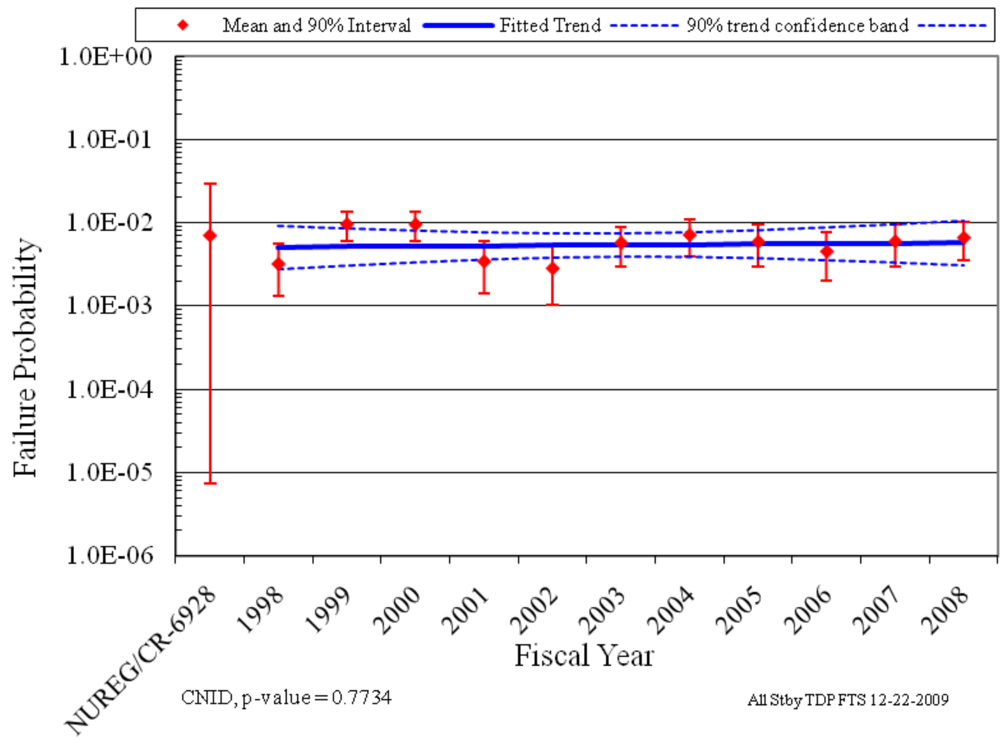


Figure 1. Standby systems, industry-wide TDP FTS trend.

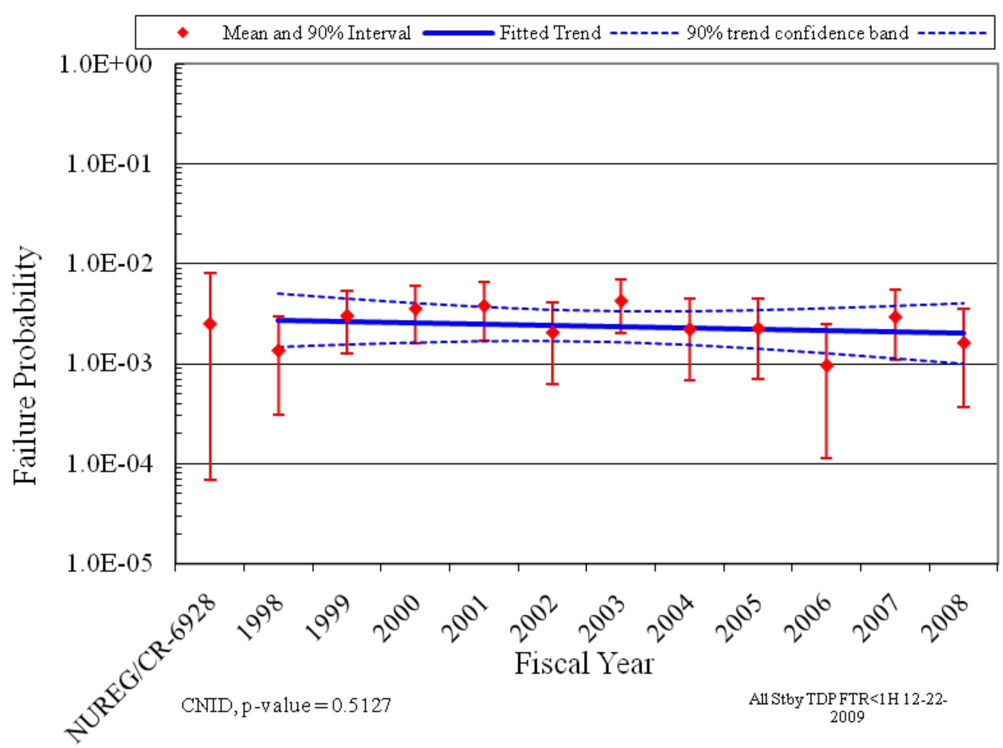


Figure 2. Standby systems, industry-wide TDP FTR≤1H trend.

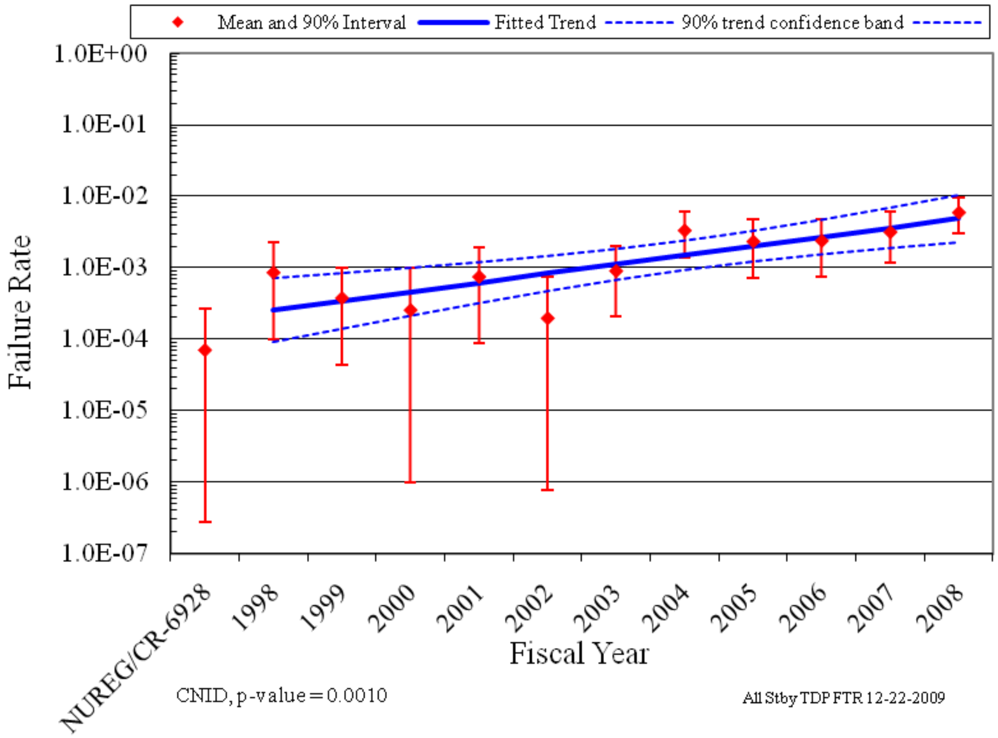


Figure 3. Standby systems, industry-wide TDP FTR>1H trend.

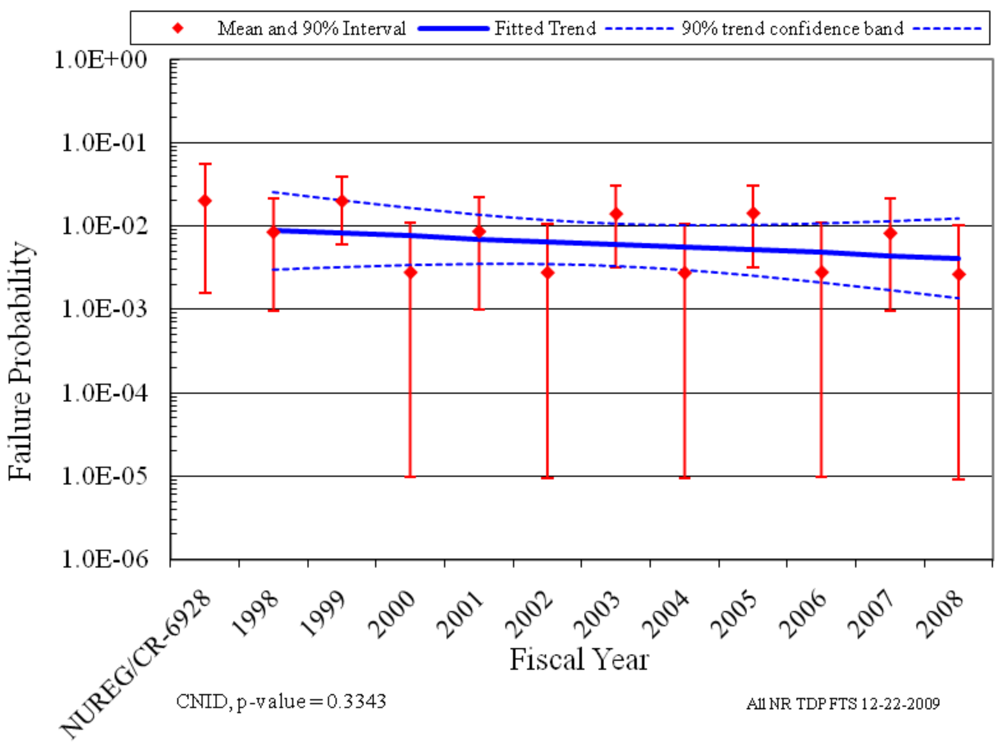


Figure 4. Normally running systems (MFW), industry-wide TDP FTS trend.

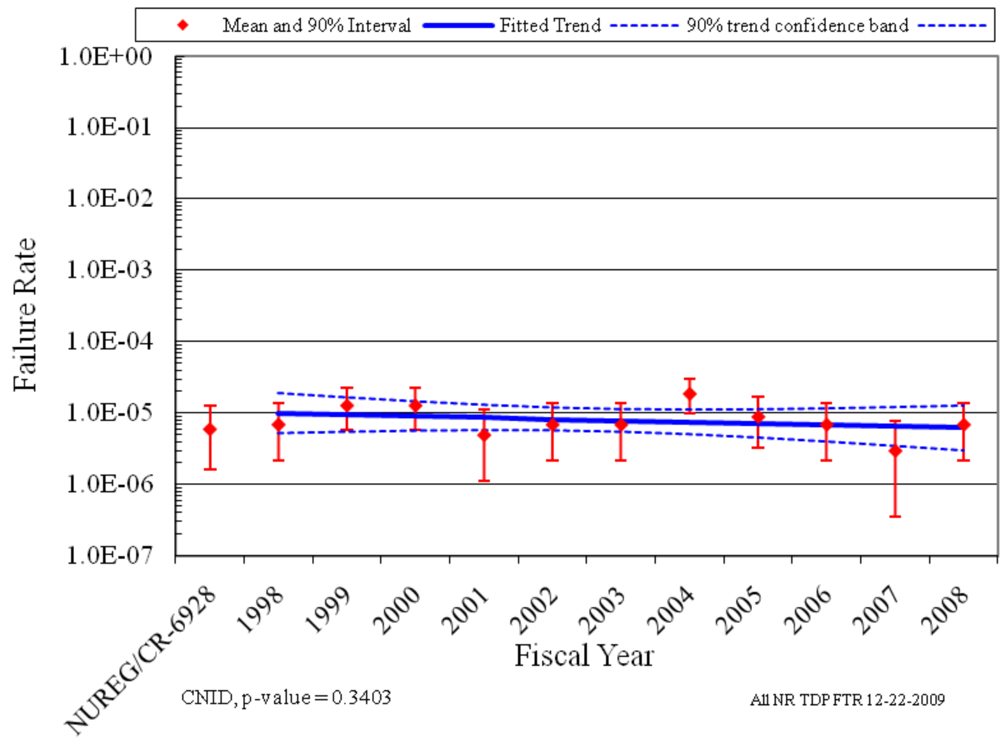


Figure 5. Normally running systems (MFW), industry-wide TDP FTR trend.

In the plots, the means of the posterior distributions from the Bayesian update process were trended across the years. The posterior distributions were also used for the vertical bounds for each year. The 5th and 95th percentiles of these distributions give an indication of the relative variation from year to year in the data. When there are no failures, the interval tends to be larger than the interval for years when there are one or more failures. The larger interval reflects the uncertainty that comes from having little information in that year's data. Such uncertainty intervals are determined by the prior distribution. In each plot, a relatively "flat" constrained noninformative prior distribution (CNID) is used, which has large bounds.

The horizontal curves plotted around the regression lines in the graphs show 90 percent simultaneous confidence bands for the fitted lines. The simultaneous confidence band bounds are larger than ordinary confidence intervals for the trended values because they form a band that has a 90% probability of containing the entire line. In the lower left hand corner of the trend figures, the regression p-values are reported. They come from a statistical test on whether the slope of the regression line might be zero. Low p-values indicate that the slopes are not likely to be zero, and that trends exist.

Further information on the trending methods is provided in Section 2 of the Overview and Reference document. A final feature of the trend graphs is that the baseline industry values from Table 2 are shown for comparison.

4 UNAVAILABILITY

4.1 Overview

The industry-wide test or maintenance unavailability (UA) of TDP trains has been calculated from the operating experience. UA data are for TDP trains, which can include more than just the TDP. However, in most cases the TDP contributes the majority of the UA reported. Table 3 shows overall results for the TDP from Reference 1 based on UA data from MSPI Basis Documents, covering 2002 to 2004. In the calculations, planned and unplanned unavailable hours for a train are combined.

Table 3. Industry-wide distributions of unavailability for TDPs.

Description	Mean	Distribution	α	β
Turbine-Driven Pump Test or Maintenance (AFW)	5.00E-03	Beta	2.00	398.00
Turbine-Driven Pump Test or Maintenance (HPCI)	1.20E-02	Beta	3.00	247.00
Turbine-Driven Pump Test or Maintenance (RCIC)	1.00E-02	Beta	5.00	495.00

4.2 TDP Unavailability Trends

For the 1998-2008 period, the following are overall maintenance unavailability data. Note that these data do not supersede the data in Table 3 for use in risk assessments.

The trend in standby TDP train unavailability is shown in Figure 6. The data for this figure is in Table 14. The TDPs in systems AFW, HPCI, and RCIC are pooled and trended (these are the systems with maintenance unavailability data currently analyzed). The trend chart shows the results of using data for each year's component unavailability data over time. The yearly (1998–2008) unavailability and reactor critical hour data were obtained from the ROP (1998 to 2001) and EPIX (2002 to 2008) data for the TDP component. The total downtimes during operation for each plant and year were summed, and divided by the corresponding number of TDP-reactor critical hours. Unavailability data for shutdown periods are not reported.

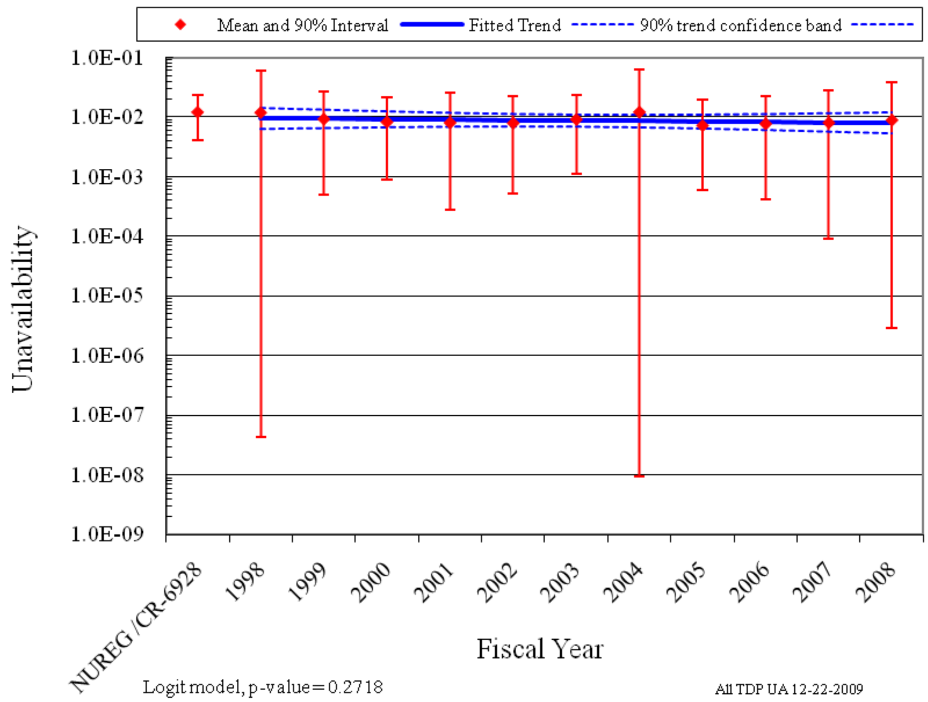


Figure 6. Pooled AFW, HPCI, and RCIC TDP UA trend.

The mean and variance for each year is the sample mean and variance calculated from the plant-level unavailabilities for that year. The vertical bar spans the calculated 5th to 95th percentiles of the beta distribution with matching means.

For the trend graphs, a least squares fit is sought for the model *logit(P)=a+bt*, where *P* is the unavailability, *t* is a year, and the logit of *P* is defined as the logarithm of *[P/(1-P)]*. Section 3 in the Overview and Reference document provides further information. In the lower left hand corner of the trend figures, the p-value is reported.

5 TDP UNRELIABILITY TRENDS

Trends in total component unreliability are shown in Figure 7 and Figure 8. Plot data for these figures are in Table 15 and Table 16, respectively. Total unreliability is defined as the result of an OR gate with the FTS, FTR≤1H, FTR >1H (or FTR), and UA as basic event inputs. The FTR>1H is calculated for 7 hours and the FTR is calculated for 8 hours to provide the results for an 8-hour mission. Since the normally running systems TDP components do not have UA data or the FTR≤1H data, there is no UA or FTR≤1H input to the OR gate for that calculation. The trending method is described in more detail in Section 4 of the Overview and Reference document. In the lower left hand corner of the trend figures, the regression method is reported.

The standby systems from Table 2 are trended together.

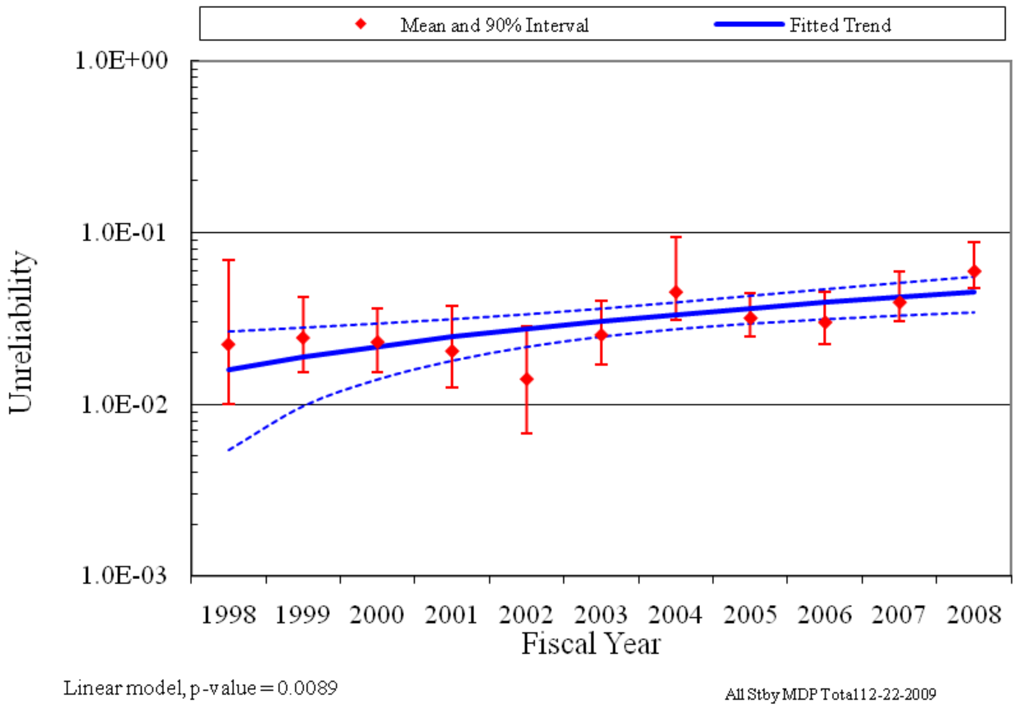


Figure 7. Standby systems, industry-wide TDP unreliability trend (8-hour mission).

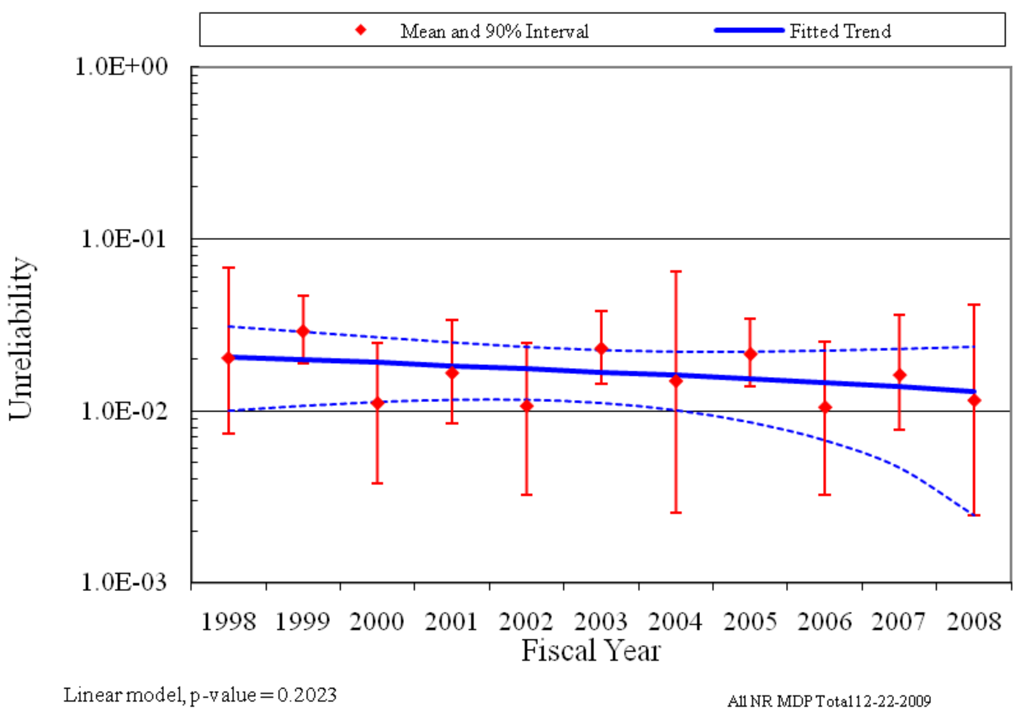


Figure 8. Normally running systems (MFW), industry-wide TDP unreliability trend (8-hour mission).

6 ENGINEERING TRENDS

This section presents frequency trends for TDP failures and demands. The data are normalized by reactor year for plants that have the equipment being trended. The rate methods described in Section 2 of the Overview and Reference document are used.

6.1 Standby TDP Engineering Trends

Figure 9 shows the trend for standby TDP start demands. Figure 10 shows the trend for TDP run ≤1 hour demands. Figure 11 shows the trend for the TDP run hours. Table 17, Table 18, and Table 19 provide the plot data, respectively.

Figure 12 shows the trend for TDP FTS events. Figure 13 shows the trend for TDP FTR≤1H events, and Figure 14 shows the trend for the TDP FTR>1H events. Table 20, Table 22, and Table 23 provide the plot data, respectively. The standby systems from Table 2 are trended together for each figure.

Table 4 summarizes the failures by system and year for the FTS failure mode. Table 5 summarizes the failures by system and year for the FTR≤1H failure mode. Table 6 summarizes the failures by system and year for the FTR>1H failure mode.

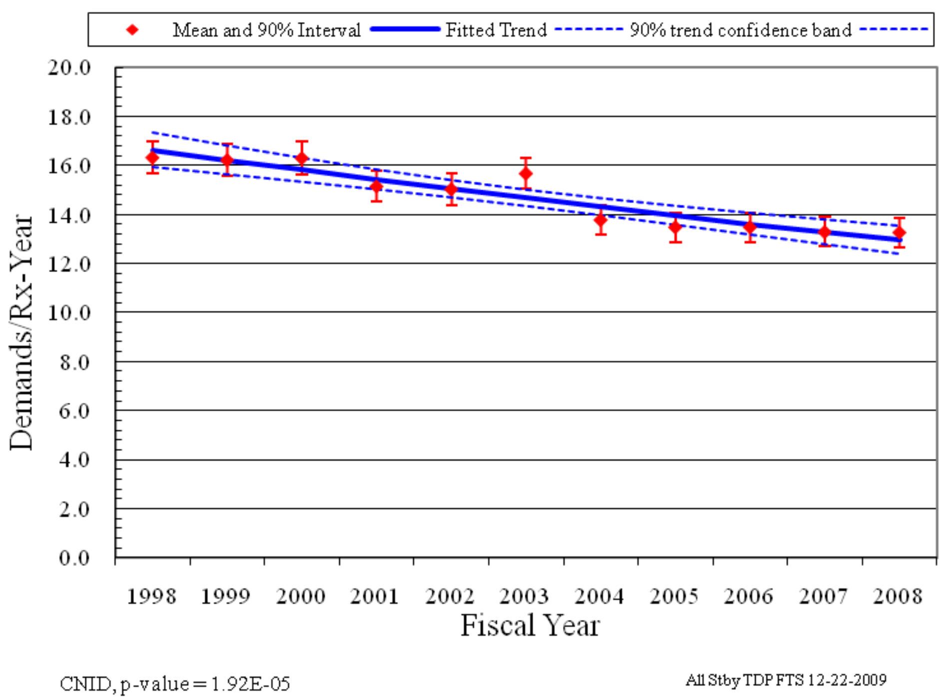


Figure 9. Frequency (events per reactor year) of start demands, standby TDPs.

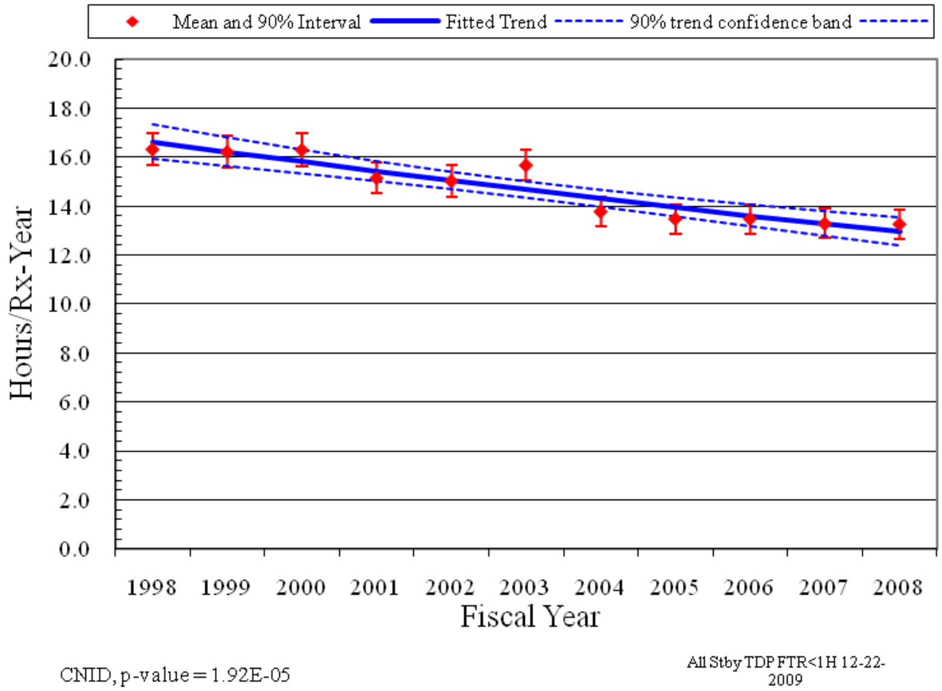


Figure 10. Standby TDP run hours per reactor critical year of run ≤ 1H hours.

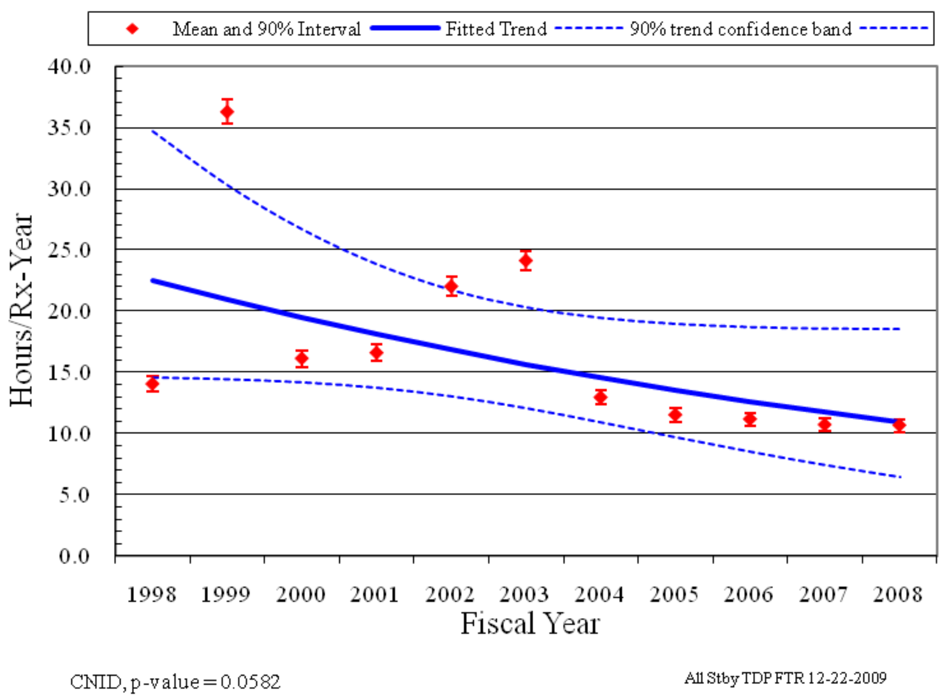


Figure 11. Standby TDP run hours per reactor critical year.

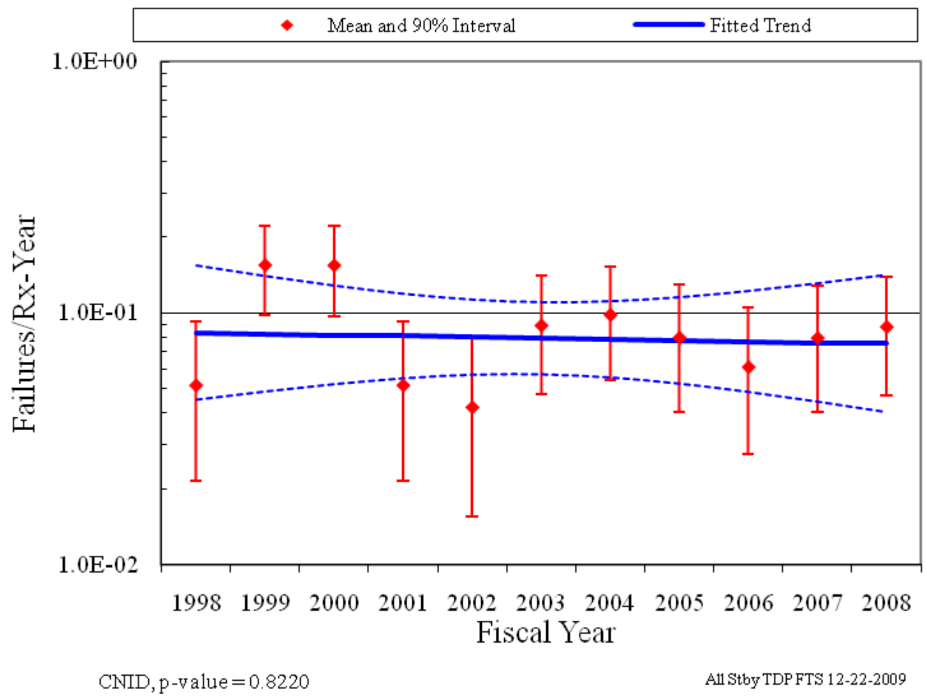


Figure 12. Frequency (events per reactor year) of FTS events, standby TDPs.

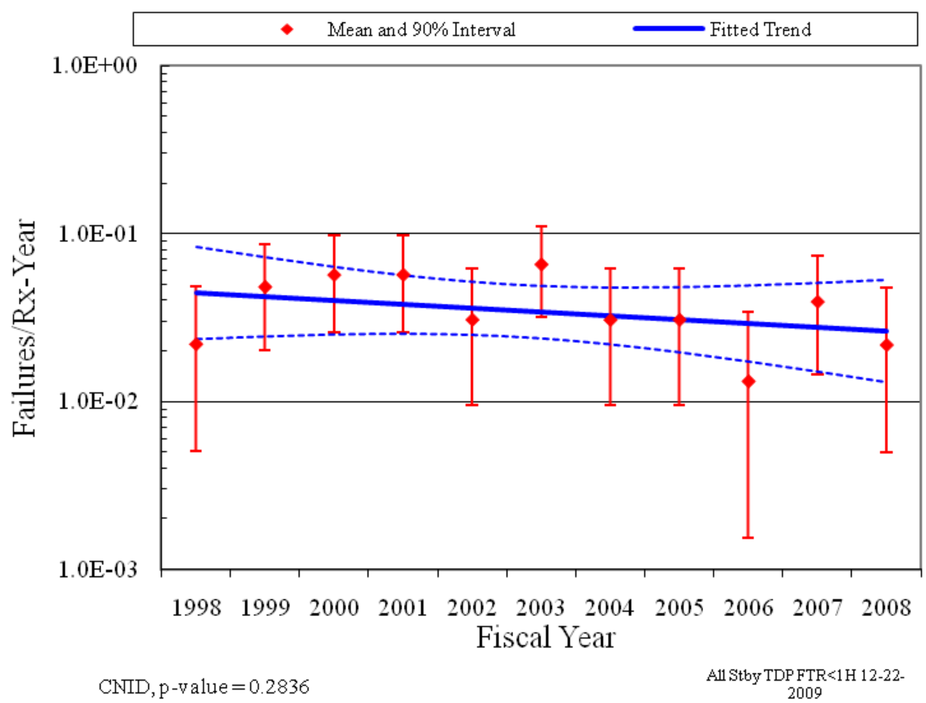


Figure 13. Frequency (events per reactor year) of FTR≤1H events, standby TDPs.

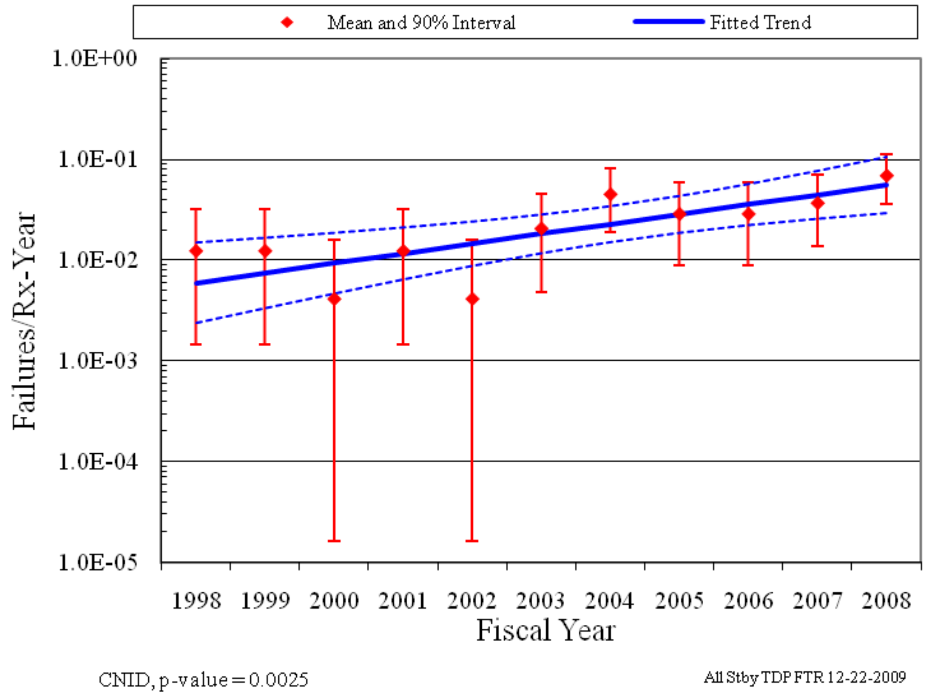


Figure 14. Frequency (events per reactor year) of FTR>1H events, standby TDPs.

6.2 Normally Running TDP Engineering Trends

Figure 15 shows the trend for TDP start demands and Figure 16 shows the trend for the TDP run hours. Table 23 and Table 24 provide the plot data, respectively.

Figure 17 shows the trend for TDP FTS events and Figure 18 shows the trend for the TDP FTR events. Table 25 and Table 26 provide the plot data, respectively. The normally running system (MFW) from Table 2 is trended for each figure.

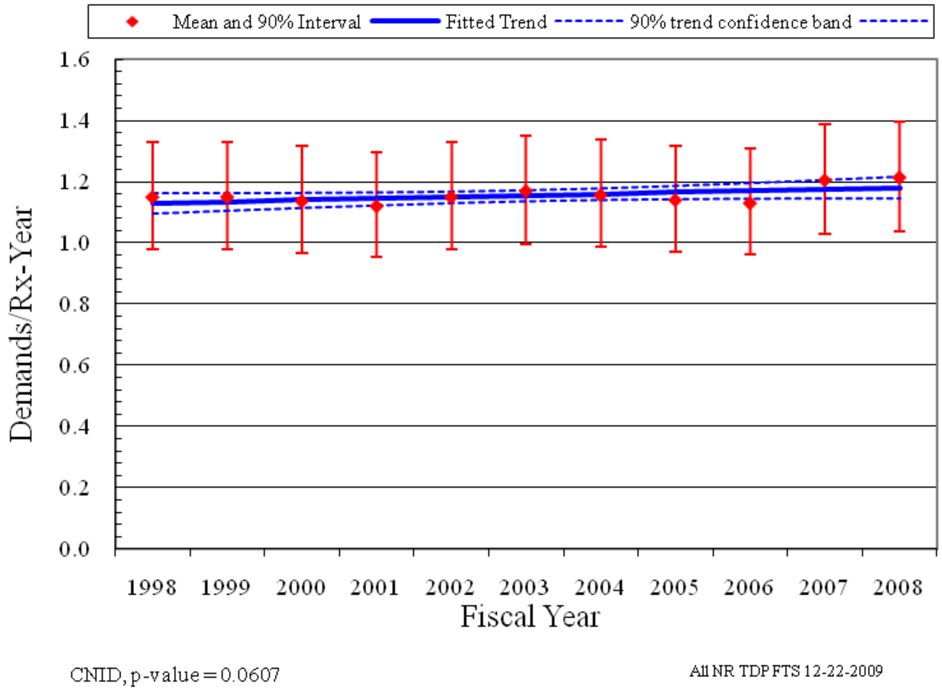


Figure 15. Frequency (events per reactor year) of start demands, normally running TDPs.

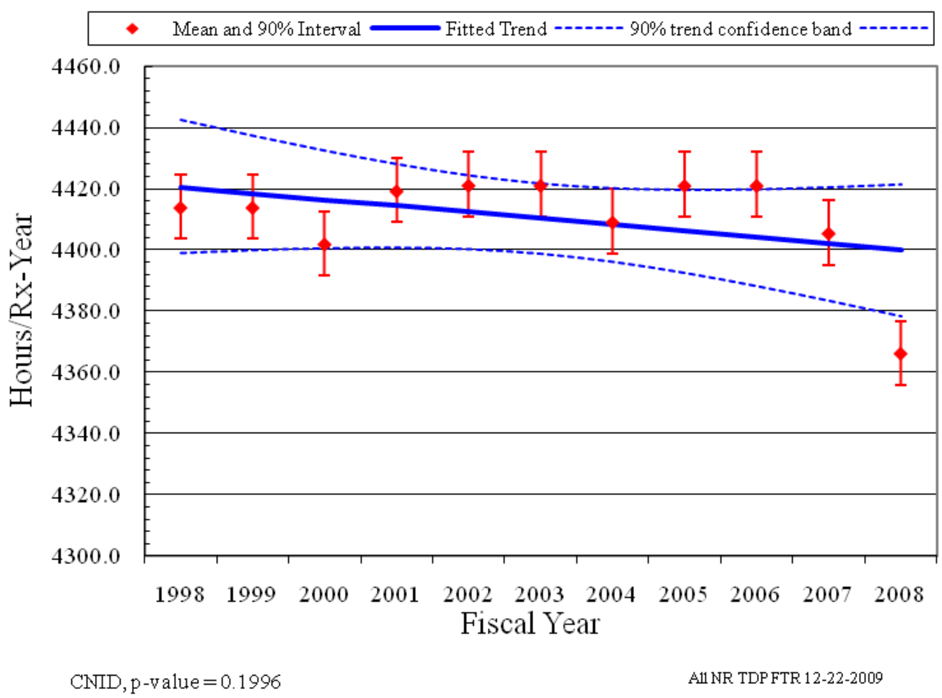


Figure 16. Normally running TDP run hours per reactor critical year.

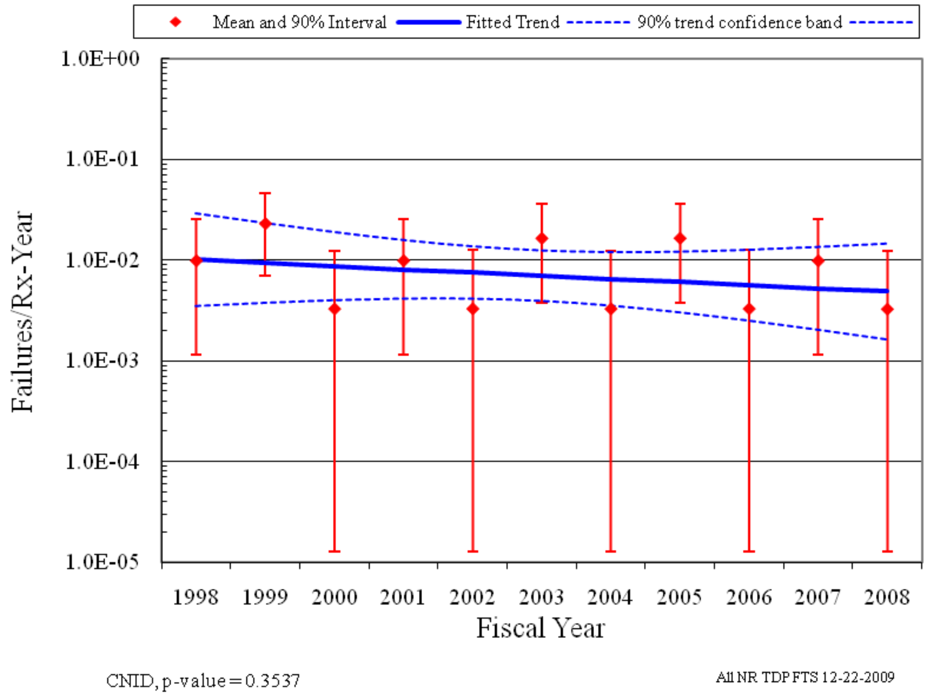


Figure 17. Frequency (events per reactor year) of FTS events, normally running TDPs.

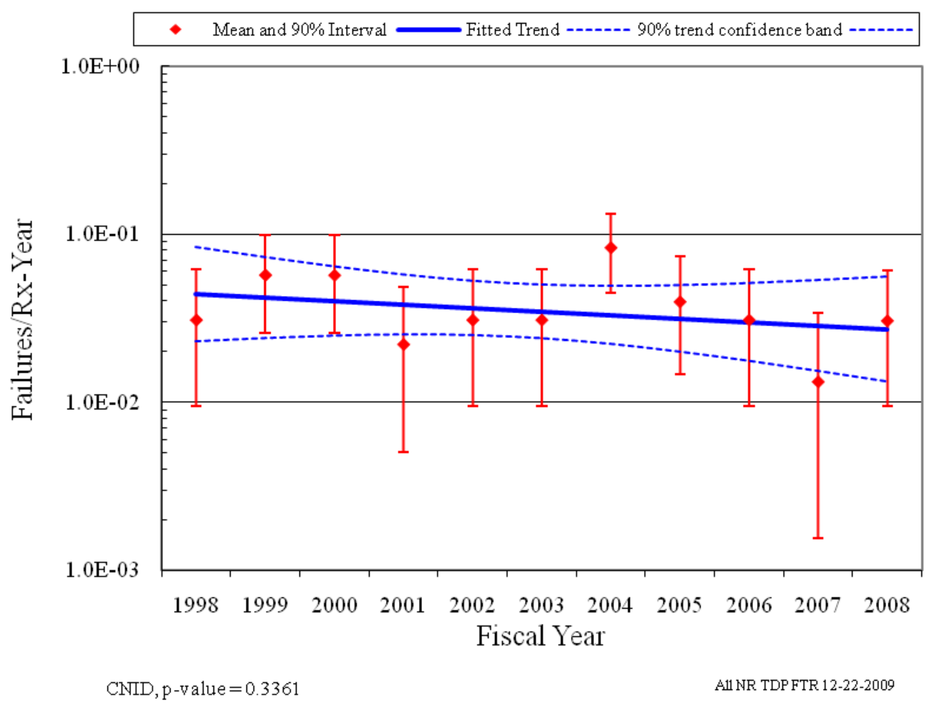


Figure 18. Frequency (events per reactor year) of FTR events, normally running TDPs.

Table 4. Summary of TDP failure counts for the FTS failure mode over time by system.

System Code	TDP Count	TDP Percent	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	Total	Percent of Failures
AFW	70	38.0%	3	6	5	3	2	5	4	4	3	3	2	40	37.0%
HPCI	25	13.6%		2	5		2	2	1	2	1	3	3	21	19.4%
MFW	58	31.5%	1	3	1	2		2		2		1		12	11.1%
RCIC	31	16.8%	2	8	6	2		2	5	2	2	2	4	35	32.4%
Total	184	100.0%	6	19	17	7	4	11	10	10	6	9	9	108	100.0%

Table 5. Summary of TDP failure counts for the FTR≤1H failure mode over time by system.

System Code	TDP Count	TDP Percent	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	Total	Percent of Failures
AFW	70	38.0%	1	4	2	4	2	6	3	1	1	2	1	27	57.4%
HPCI	25	13.6%			2	1		1				1	1	6	12.8%
MFW	58	31.5%	1			1				1		1	1	5	10.6%
RCIC	31	16.8%	1	1	2	1	1			2		1		9	19.1%
Total	184	100.0%	3	5	6	7	3	7	3	4	1	5	3	47	100.0%

Table 6. Summary of TDP failure counts for the FTR>1H and FTR failure mode over time by system.

System Code	TDP Count	TDP Percent	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	Total	Percent of Failures
AFW	70	38.0%				1			3	2	3		4	13	17.3%
HPCI	25	13.6%						2	1			2	2	7	9.3%
MFW	58	31.5%	3	6	6	4	4	3	9	4	3	2	3	47	62.7%
RCIC	31	16.8%	1	1					1	1		2	2	8	10.7%
Total	184	100.0%	4	7	6	5	4	5	14	7	6	6	11	75	100.0%

6.3 Comparison of EPIX TDP Unplanned Demand Results with Industry Results for Standby Components

An ongoing concern in the industry is whether a combination of test, non-test demand, and actual demand data adequately represent standby component performance during unplanned demands. This comparison evaluates the same dataset for standby components that is used for the overall trends shown in this document, but limits the failure data to those that are discovered during an ESF demand and the ESF demands reported in EPIX. The data are further limited to FY 2003 to present since the ESF demand reporting in EPIX is inconsistent prior to FY 2003.

The standby TDP ESF unplanned demand data covering FY 2003 – 2008 are summarized in Table 7. Consistency between the unplanned demand data and industry-average performance from Table 2 was evaluated using the predictive distribution approach outlined in the *Handbook of Parameter Estimation for Probabilistic Risk Assessment*, NUREG/CR-6823, Sections 6.2.3.5 and 6.3.3.4 [Reference 2]. Simulation is required.

The unplanned demand data were aggregated at the plant and system level (failures and demands). Assuming each plant and system can have a different failure probability, the industry-average distribution (from Table 2) was sampled for each plant and system. The predicted number of failure events for each plant and system was evaluated using the binomial distribution with the plant-specific failure probability and its associated number of demands. Then the total number of predicted failures was obtained by summing the individual plant results. This process was repeated 1000 times (Latin hypercube sampling), each time obtaining a total number of predicted failures. The 1000 sample results were ordered from high to low. Then the actual number of unplanned demand failures observed (listed in Table 7) was compared with this ordered sample to determine the probability of observing this number of failures or greater. If the probability was greater than 0.05 and less than 0.95, then the unplanned demand performance was considered to be consistent with the industry-average distribution obtained from the EPIX data analysis.

Table 7. Standby TDP unplanned demand performance comparison with industry-average performance.

Failure Modes	Plants	Demands or Hours	Failures	Expected Failures	Probability of ≥ Failures	Consistent with Industry-Average Performance?
FTS	95	276	3	1.9	2.83E-01	Yes
FTR<1H	95	276	5	0.7	1.00E-03	No
FTR	95	278.8 h	3	0.2	0.00E+00	No
Total TDP Unreliability (8 hours)	95	276 and 278.8 h	11	2.8	1.00E-03	No

The consistency checks using unplanned demand data indicate that the FTS failure observations are consistent with their industry-average distribution from Table 2. Two unplanned demand failure mode observations (FTR and FTR<1H) and the Total TDP unreliability are not consistent and lie in the lower 95% (degraded performance).

6.4 TDP Engineering Analysis by Failure Modes

The engineering analysis of TDP failure sub-components, causes, detection methods, and recovery possibility are presented in this section. Each analysis divides the events into two periods: before July 2003 and after July 2003 (the start of the data begins in FY 1998 and the last date is FY 2008). This breakdown was chosen for two reasons: first, July 2003 represents a point in which the MSPI data collection attains a "higher level" of scrutiny; second, this date represents a point about half way through the full data period.

The second division of the events is by the failure mode determined after EPIX data review by the staff. See Section **Error! Reference source not found.** for more description of failure modes.

TDP sub-component contributions to the three failure modes are presented in Figure 19. The sub-component contributions are similar to those used in the CCF database. The driver (specifically the governor) has the highest percentage contributions to failures for all three failure modes.

TDP cause group contributions to the three failure modes are presented in

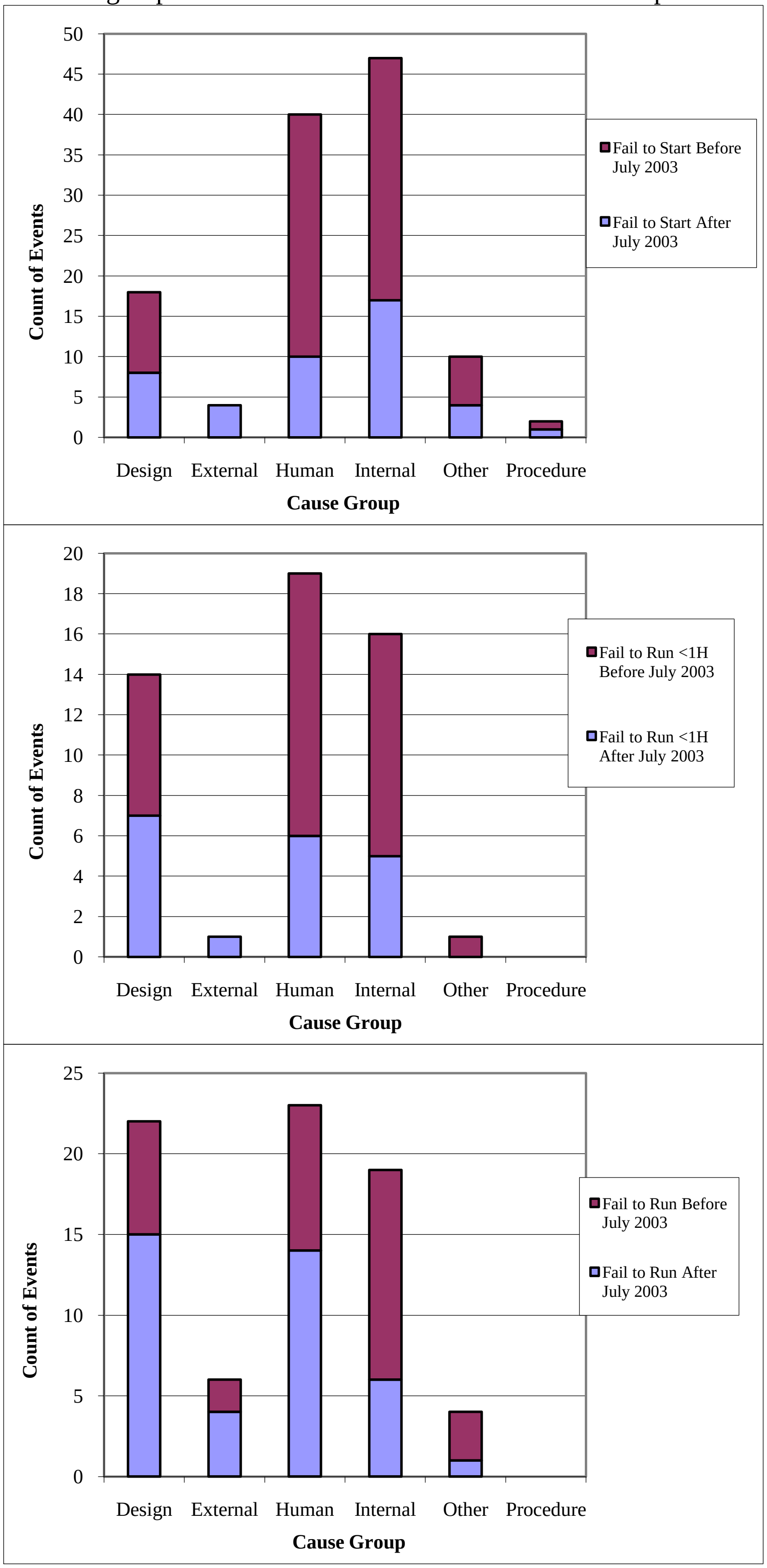
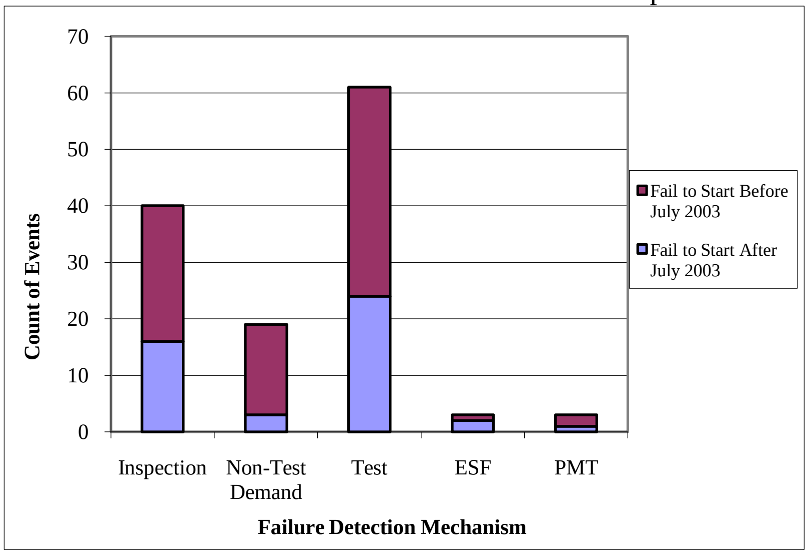
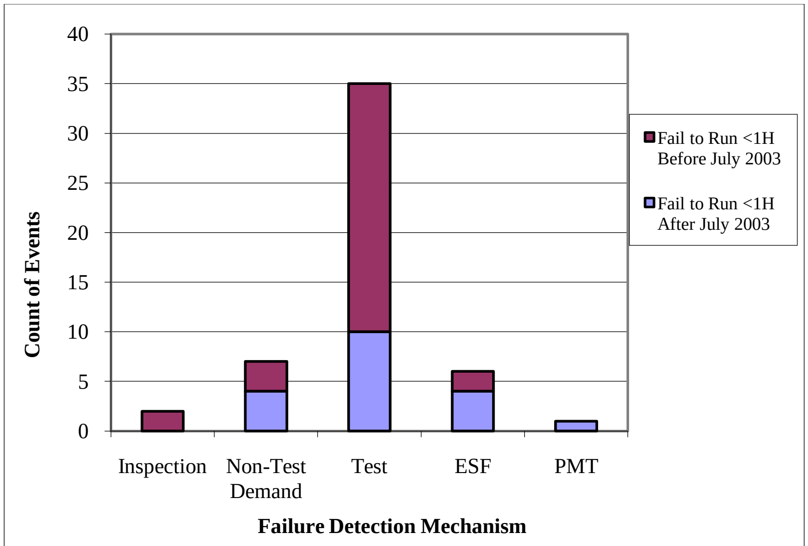


Figure 20. The cause groups are similar to those used in the CCF database. Table 8 shows the breakdown of the cause groups with the specific causes that were coded during the data collection. The most likely causes are human errors, design issues, and internal faults. Internal means that the cause was related to something within the TDP component such as a worn out part or the normal internal environment. Of particular interest is the Design cause group under the fail to run failure mode. Notice that this group increased in importance in the current period over the previous period.

TDP detection methods to the three failure modes are presented in





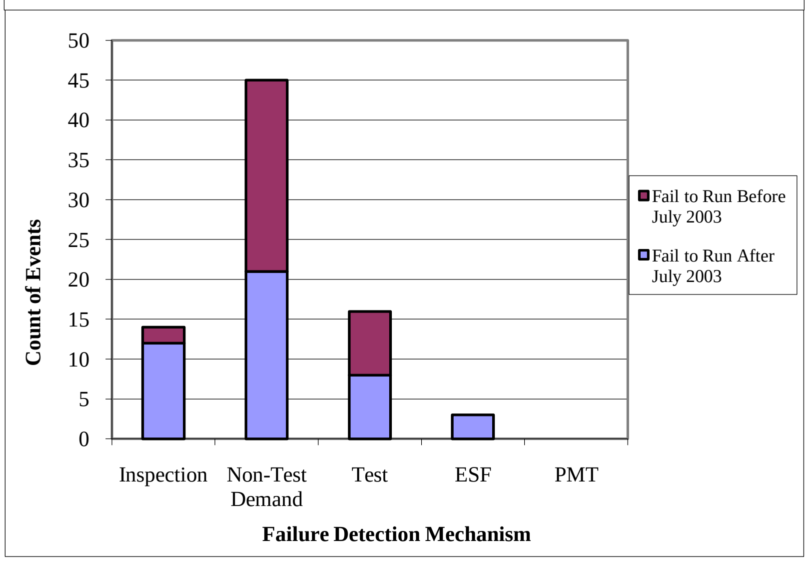


Figure 21. The most likely detection method for FTS and FTR≤1H is testing, which is the prevalent detection method for most standby components. The prevalent FTR detection is non-test demands.

TDP recovery to the three failure modes are presented in

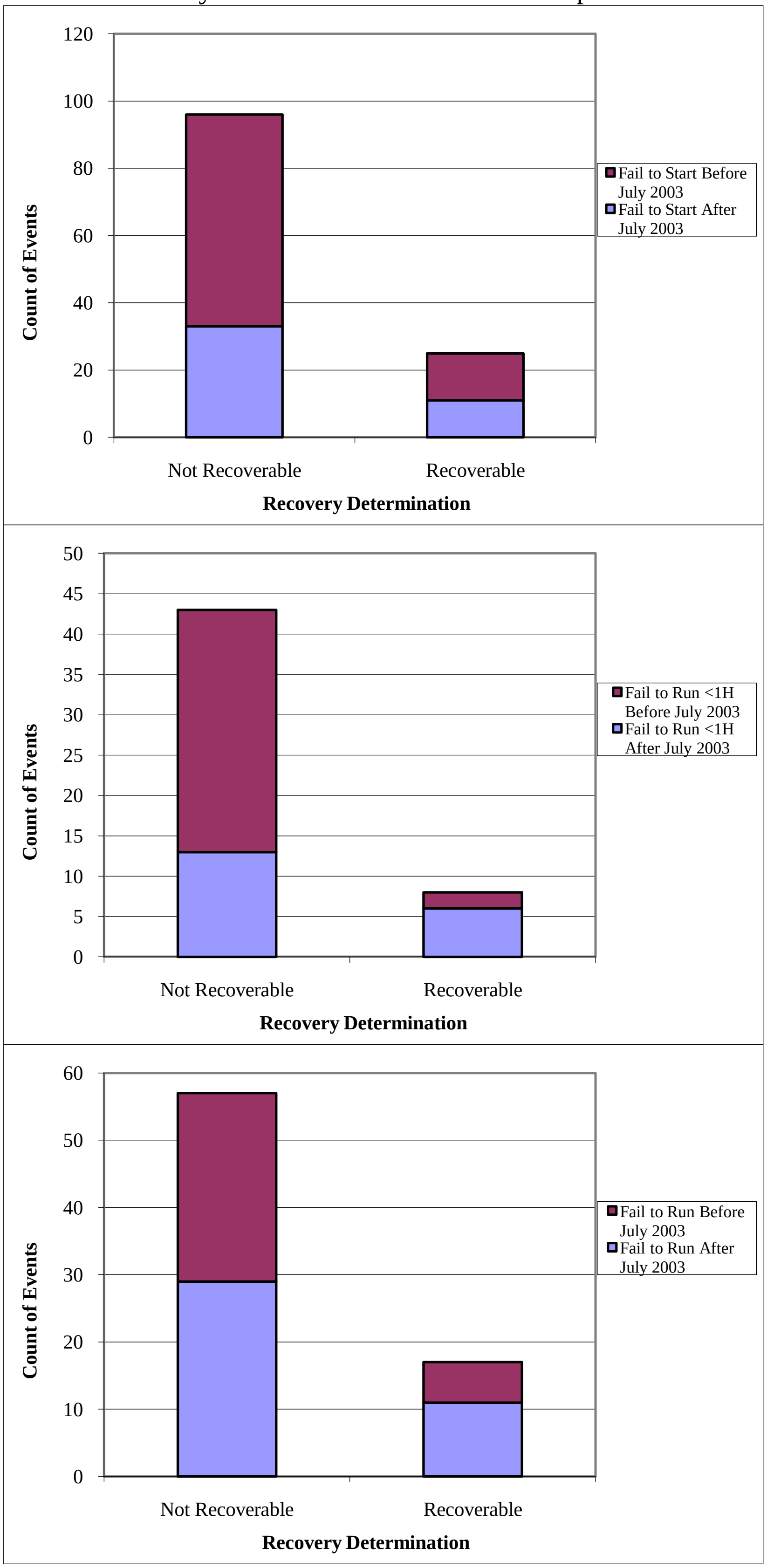


Figure 22. The overall non-recovery to recovery ratio is approximately 4:1.

Table 8. TDP component failure cause groups.

Group	Specific Cause	Description
Design	Construction/installation error or inadequacy	Used when a construction or installation error is made during the original or modification installation. This includes specification of incorrect component or material.
Design	Design error or inadequacy	Used when a design error is made.
Design	Manufacturing error or inadequacy	Used when a manufacturing error is made during component manufacture.
External	State of other component	Used when the cause of a failure is the result of a component state that is not associated with the component that failed. An example would be the diesel failed due to no fuel in the fuel storage tanks.
External	Ambient environmental stress	Used when the cause of a failure is the result of an environmental condition from the location of the component.
Human	Accidental action (unintentional or undesired human errors)	Used when a human error (during the performance of an activity) results in an unintentional or undesired action.
Human	Human action procedure	Used when the procedure is not followed or the procedure is incorrect. For example: when a missed step or incorrect step in a surveillance procedure results in a component failure.
Human	Inadequate maintenance	Used when a human error (during the performance of maintenance) results in an unintentional or undesired action.
Internal	Internal to component, piece-part	Used when the cause of a failure is a non-specific result of a failure internal to the component that failed other than aging or wear.
Internal	Internal environment	The internal environment led to the failure. Debris/Foreign material as well as an operating medium chemistry issue.
Internal	Setpoint drift	Used when the cause of a failure is the result of setpoint drift or adjustment.
Internal	Age/Wear	Used when the cause of the failure is a non-specific aging or wear issue.
Other	Unknown	Used when the cause of the failure is not known.
Other	Other (stated cause does not fit other categories)	Used when the cause of a failure is provided but it does not meet any one of the descriptions.
Procedure	Inadequate procedure	Used when the cause of a failure is the result of an inadequate procedure operating or maintenance.

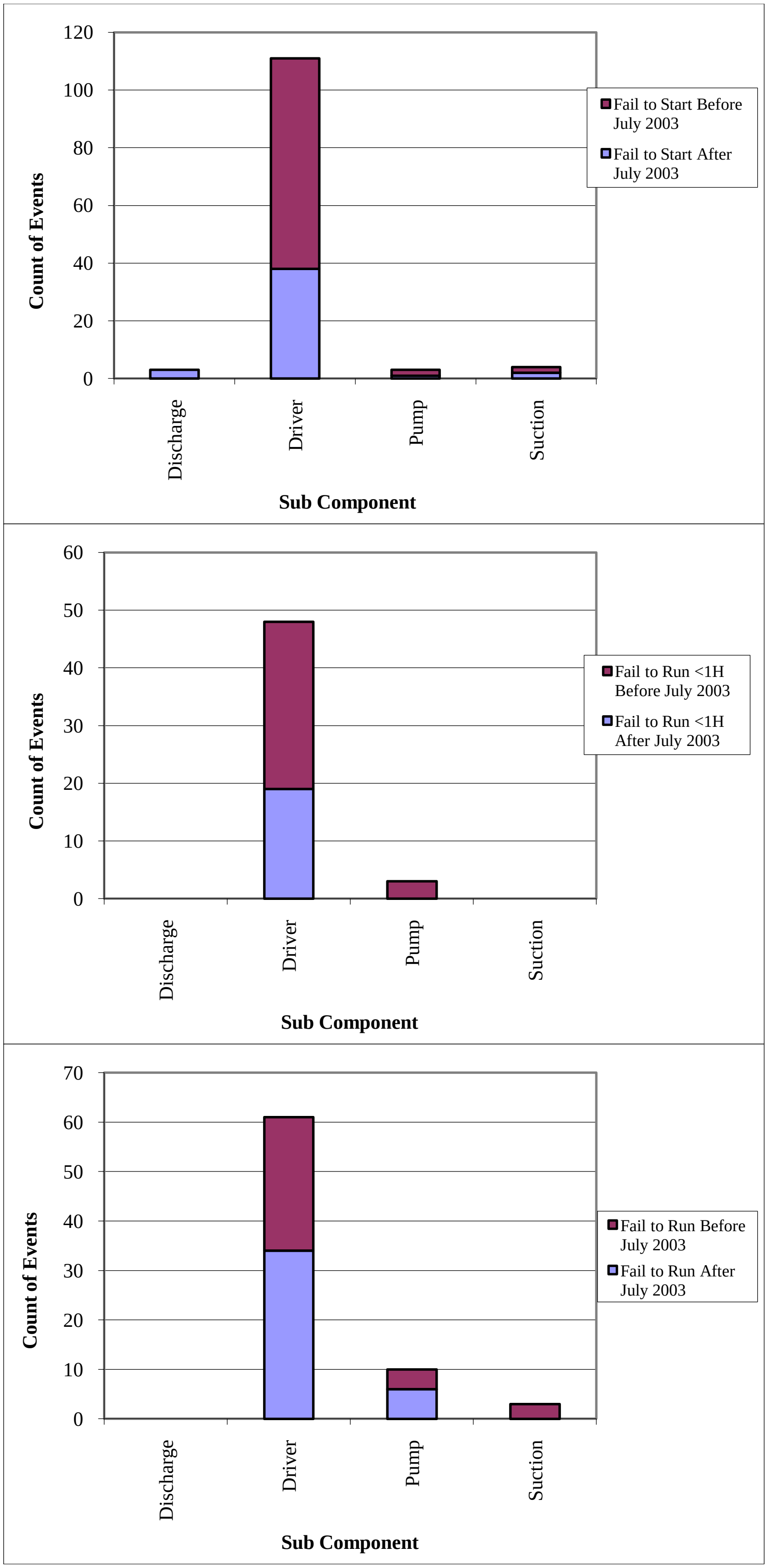


Figure 19. TDP failure breakdown by period, sub component, and failure mode.

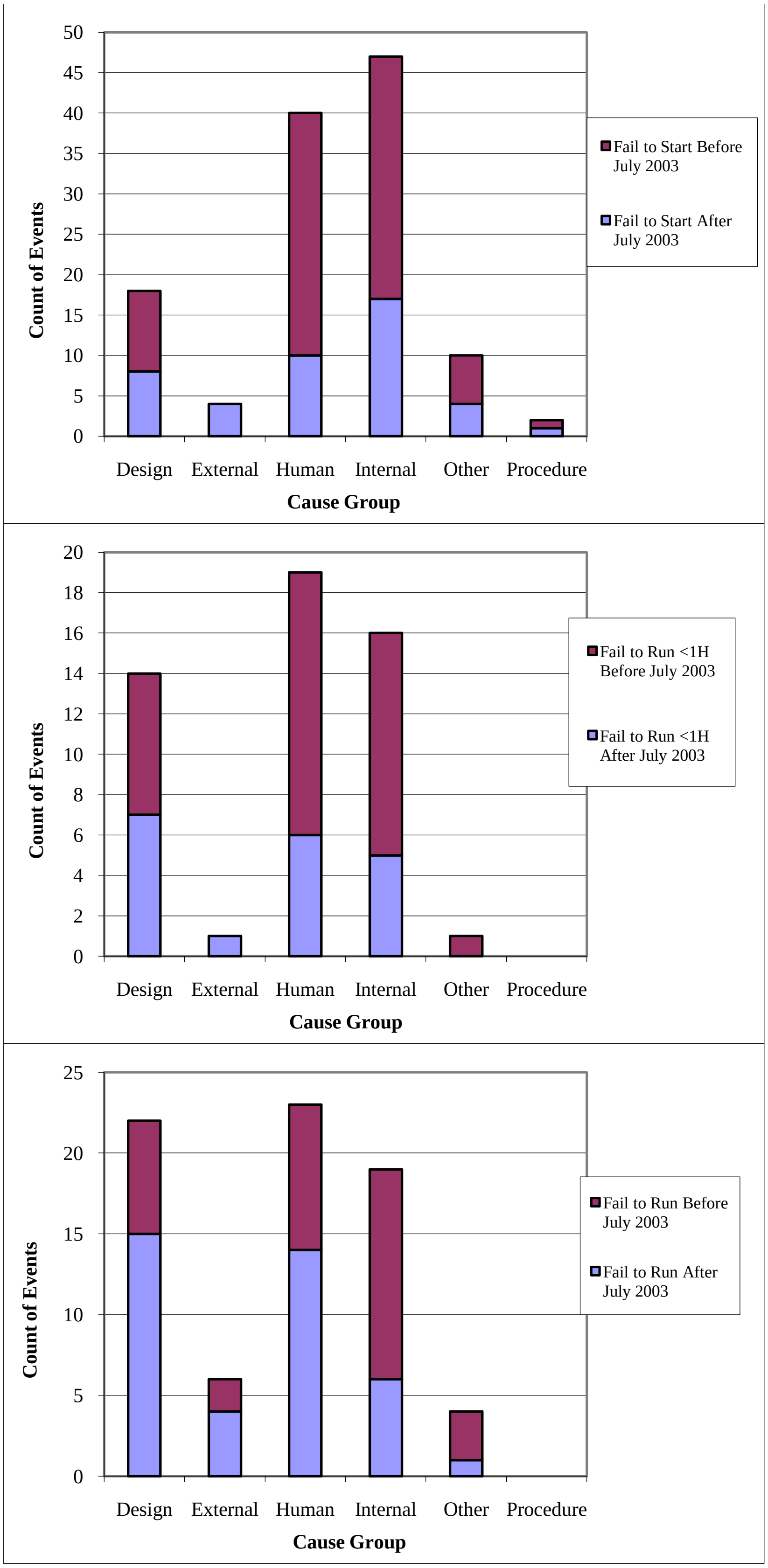


Figure 20. TDP breakdown by time period, cause group, and failure mode.

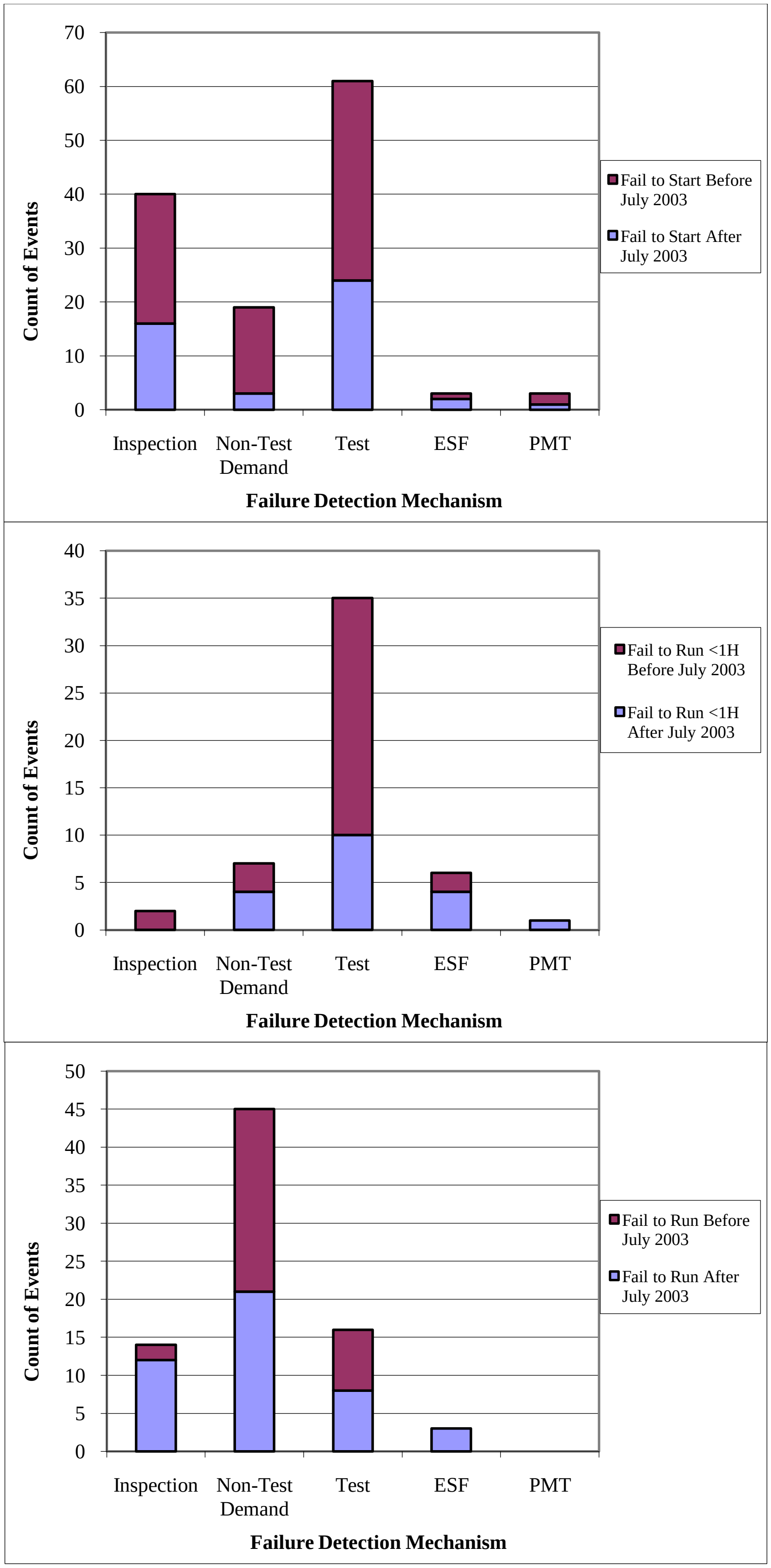


Figure 21. TDP component failure distribution by period, failure mode, and method of detection.

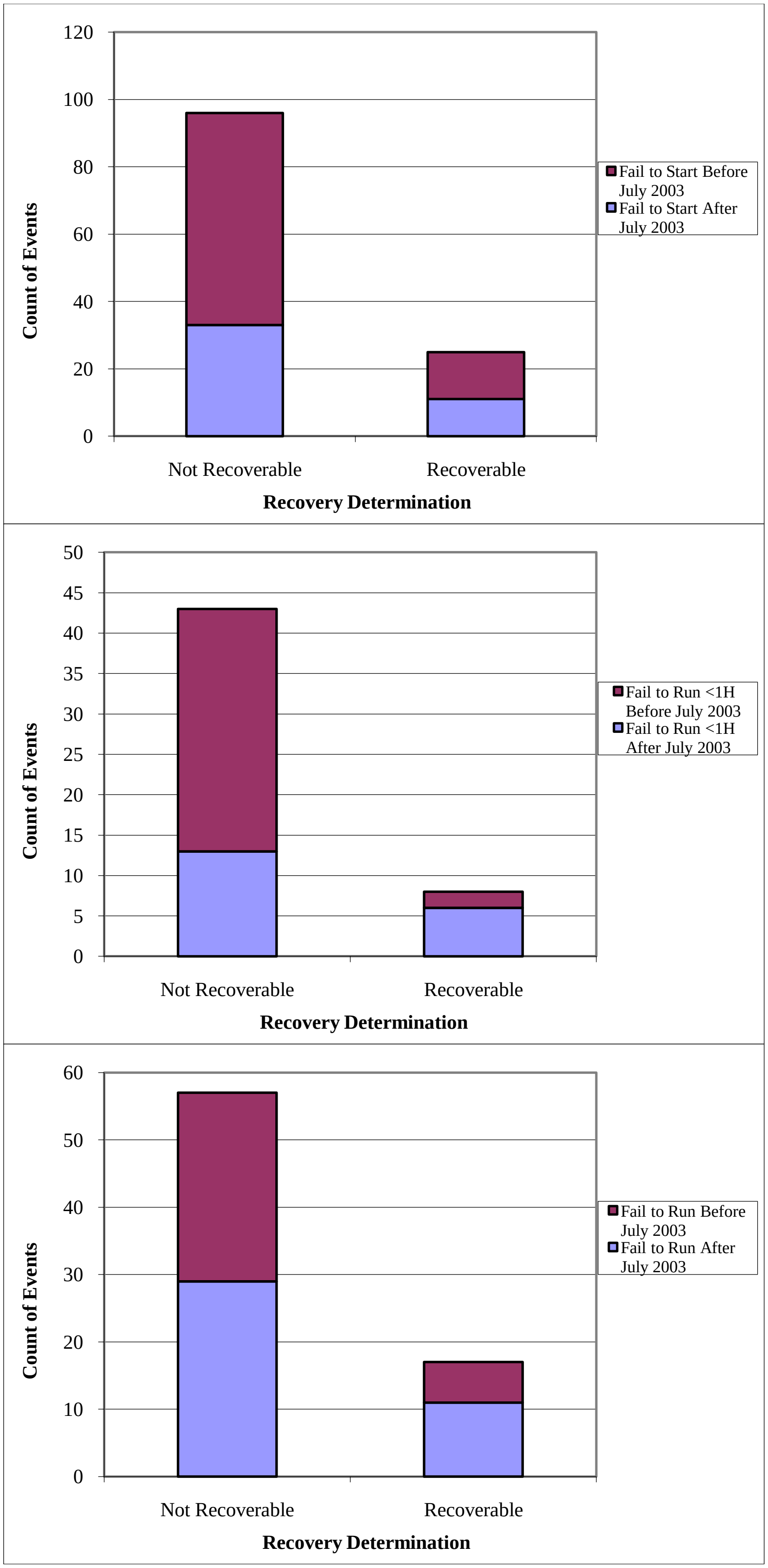


Figure 22. TDP component failure distribution by period, failure mode, and recovery.

7 TDP ASSEMBLY DESCRIPTION

The TDP is generally comprised of a pump, a turbine driver, and a governor. Most plant designs use a single stage “Terry Turbine”, whose piece-parts include a turbine trip and throttle valve, a mechanical overspeed trip mechanism, and a lubrication system. The various types of governors, used for turbine speed control are mostly manufactured by the Woodward Corporation. For the AFW system TDP, the governors are predominantly mechanical/hydraulic; pressure-compensated, and have a pneumatic remote speed-setting capability. For the RCIC and HPCI systems, the TDPs typically have a Woodward type EG-M electric/electronic governor and EG-R hydraulic actuators. Piece-parts of all governors include a turbine stop valve and a governor valve, while the EG-M usually includes a ramp generator/signal converter and other electrical controls.

8 DATA TABLES

Table 9. Plot data for standby TDP FTS industry trend. Figure 1

FY/ Source	Failures	Demands	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
NUREG /CR-6928						7.26E-06	2.91E-02	7.00E-03
1998	5	1648.6	5.10E-03	2.79E-03	9.30E-03	1.31E-03	5.65E-03	3.17E-03
1999	16	1639.3	5.16E-03	3.07E-03	8.66E-03	6.01E-03	1.36E-02	9.57E-03
2000	16	1651.0	5.22E-03	3.35E-03	8.14E-03	5.97E-03	1.35E-02	9.51E-03
2001	5	1529.8	5.29E-03	3.61E-03	7.74E-03	1.41E-03	6.06E-03	3.40E-03
2002	4	1518.3	5.36E-03	3.81E-03	7.53E-03	1.03E-03	5.25E-03	2.80E-03
2003	9	1583.0	5.42E-03	3.91E-03	7.53E-03	3.02E-03	8.97E-03	5.70E-03
2004	10	1394.6	5.49E-03	3.88E-03	7.77E-03	3.90E-03	1.09E-02	7.10E-03
2005	8	1361.3	5.56E-03	3.75E-03	8.24E-03	2.98E-03	9.47E-03	5.88E-03
2006	6	1361.3	5.63E-03	3.56E-03	8.91E-03	2.03E-03	7.69E-03	4.49E-03
2007	8	1345.8	5.70E-03	3.33E-03	9.74E-03	3.02E-03	9.57E-03	5.94E-03
2008	9	1355.9	5.77E-03	3.10E-03	1.07E-02	3.49E-03	1.04E-02	6.59E-03

Table 10. Plot data for standby TDP FTR≤1H industry trend. Figure 2

FY/ Source	Failures	Hours	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
NUREG /CR-6928						6.84E-05	8.11E-03	2.50E-03
1998	2	1648.6	2.72E-03	1.47E-03	5.02E-03	3.11E-04	3.01E-03	1.36E-03
1999	5	1639.3	2.64E-03	1.56E-03	4.47E-03	1.25E-03	5.37E-03	3.00E-03
2000	6	1651.0	2.56E-03	1.63E-03	4.01E-03	1.60E-03	6.06E-03	3.53E-03
2001	6	1529.8	2.48E-03	1.68E-03	3.66E-03	1.71E-03	6.49E-03	3.77E-03
2002	3	1518.3	2.41E-03	1.69E-03	3.43E-03	6.33E-04	4.11E-03	2.05E-03
2003	7	1583.0	2.33E-03	1.64E-03	3.31E-03	2.04E-03	7.04E-03	4.22E-03
2004	3	1394.6	2.26E-03	1.55E-03	3.31E-03	6.83E-04	4.43E-03	2.20E-03
2005	3	1361.3	2.20E-03	1.42E-03	3.40E-03	6.97E-04	4.53E-03	2.25E-03
2006	1	1361.3	2.13E-03	1.28E-03	3.55E-03	1.13E-04	2.51E-03	9.65E-04
2007	4	1345.8	2.06E-03	1.14E-03	3.75E-03	1.08E-03	5.50E-03	2.92E-03
2008	2	1355.9	2.00E-03	1.00E-03	3.99E-03	3.70E-04	3.57E-03	1.61E-03

Table 11. Plot data for standby TDP FTR>1H industry trend. Figure 3

FY/ Source	Failures	Run Time (h)	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
NUREG /CR-6928						2.75E-07	2.69E-04	7.00E-05
1998	1	1416.1	2.56E-04	9.10E-05	7.21E-04	1.01E-04	2.24E-03	8.59E-04
1999	1	3663.0	3.44E-04	1.39E-04	8.48E-04	4.41E-05	9.79E-04	3.76E-04
2000	0	1630.7	4.62E-04	2.12E-04	1.01E-03	1.00E-06	9.80E-04	2.55E-04
2001	1	1673.3	6.20E-04	3.19E-04	1.20E-03	8.78E-05	1.95E-03	7.49E-04
2002	0	2221.0	8.32E-04	4.71E-04	1.47E-03	7.71E-07	7.53E-04	1.96E-04
2003	2	2434.2	1.12E-03	6.76E-04	1.85E-03	2.07E-04	2.00E-03	9.04E-04
2004	5	1307.8	1.50E-03	9.32E-04	2.41E-03	1.40E-03	6.01E-03	3.36E-03
2005	3	1160.1	2.01E-03	1.23E-03	3.31E-03	7.27E-04	4.72E-03	2.35E-03
2006	3	1124.5	2.70E-03	1.55E-03	4.72E-03	7.45E-04	4.84E-03	2.41E-03
2007	4	1082.7	3.63E-03	1.89E-03	6.96E-03	1.18E-03	5.99E-03	3.19E-03
2008	8	1087.6	4.87E-03	2.27E-03	1.04E-02	3.06E-03	9.73E-03	6.00E-03

Table 12. Plot data for normally running TDP FTS industry trend. Figure 4

FY/ Source	Failures	Demands	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
NUREG /CR-6928						1.55E-03	5.62E-02	2.00E-02
1998	1	116.3	8.83E-03	3.03E-03	2.55E-02	9.75E-04	2.18E-02	8.45E-03
1999	3	116.1	8.18E-03	3.25E-03	2.04E-02	6.06E-03	3.88E-02	1.98E-02
2000	0	114.8	7.58E-03	3.45E-03	1.66E-02	9.62E-06	1.08E-02	2.79E-03
2001	1	113.3	7.02E-03	3.56E-03	1.38E-02	9.92E-04	2.22E-02	8.59E-03
2002	0	116.0	6.51E-03	3.54E-03	1.19E-02	9.55E-06	1.07E-02	2.77E-03
2003	2	118.3	6.03E-03	3.35E-03	1.08E-02	3.16E-03	3.04E-02	1.40E-02
2004	0	117.3	5.58E-03	3.00E-03	1.04E-02	9.48E-06	1.06E-02	2.75E-03
2005	2	115.3	5.17E-03	2.55E-03	1.04E-02	3.22E-03	3.09E-02	1.42E-02
2006	0	114.3	4.79E-03	2.10E-03	1.09E-02	9.65E-06	1.08E-02	2.80E-03
2007	1	121.6	4.43E-03	1.69E-03	1.16E-02	9.47E-04	2.12E-02	8.20E-03
2008	0	124.0	4.11E-03	1.35E-03	1.25E-02	9.14E-06	1.02E-02	2.65E-03

Table 13. Plot data for normally running TDP FTR industry trend. Figure 5

FY/ Source	Failures	Run Time (h)	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
NUREG /CR-6928						1.64E-06	1.26E-05	6.00E-06
1998	3	445799.6	9.93E-06	5.20E-06	1.90E-05	2.16E-06	1.40E-05	6.97E-06
1999	6	445799.6	9.47E-06	5.44E-06	1.65E-05	5.87E-06	2.23E-05	1.29E-05
2000	6	445799.6	9.04E-06	5.62E-06	1.45E-05	5.87E-06	2.23E-05	1.29E-05
2001	2	446347.1	8.62E-06	5.72E-06	1.30E-05	1.14E-06	1.10E-05	4.97E-06
2002	3	446534.6	8.22E-06	5.67E-06	1.19E-05	2.15E-06	1.40E-05	6.96E-06
2003	3	446532.3	7.84E-06	5.44E-06	1.13E-05	2.15E-06	1.40E-05	6.96E-06
2004	9	446529.8	7.48E-06	5.04E-06	1.11E-05	1.01E-05	3.00E-05	1.89E-05
2005	4	446528.2	7.13E-06	4.53E-06	1.12E-05	3.31E-06	1.68E-05	8.95E-06
2006	3	446527.7	6.80E-06	4.00E-06	1.16E-05	2.15E-06	1.40E-05	6.96E-06
2007	1	446536.8	6.49E-06	3.49E-06	1.21E-05	3.50E-07	7.77E-06	2.98E-06
2008	3	446529.8	6.19E-06	3.03E-06	1.27E-05	2.15E-06	1.40E-05	6.96E-06

Table 14. Plot data for all standby TDP unavailability trend. Figure 6

FY	UA Hours	Critical Hours	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	6308.3	641458.4	9.60E-03	6.36E-03	1.45E-02	4.26E-08	5.94E-02	1.18E-02
1999	8294.8	922022.3	9.42E-03	6.60E-03	1.34E-02	5.09E-04	2.71E-02	9.18E-03
2000	7871.6	954887.4	9.25E-03	6.83E-03	1.25E-02	8.81E-04	2.16E-02	8.19E-03
2001	7569.2	959741.4	9.08E-03	6.99E-03	1.18E-02	2.77E-04	2.50E-02	7.97E-03
2002	7612.4	961200.2	8.91E-03	7.07E-03	1.12E-02	5.30E-04	2.24E-02	7.83E-03
2003	8558.7	942160.3	8.74E-03	7.01E-03	1.09E-02	1.10E-03	2.33E-02	9.06E-03
2004	9642.0	992486.6	8.58E-03	6.81E-03	1.08E-02	9.53E-09	6.26E-02	1.20E-02
2005	7098.9	1007034.0	8.42E-03	6.49E-03	1.09E-02	5.92E-04	1.97E-02	7.11E-03
2006	7682.1	1014750.0	8.27E-03	6.10E-03	1.12E-02	4.12E-04	2.26E-02	7.62E-03
2007	8069.3	1017433.0	8.11E-03	5.69E-03	1.16E-02	9.22E-05	2.80E-02	7.94E-03
2008	8190.9	988665.8	7.96E-03	5.27E-03	1.20E-02	2.95E-06	3.85E-02	8.81E-03

Table 15. Plot data for Standby TDP unreliability trend. Figure 7

FY	Regression Curve Data Points			Plot Trend Error Bar Points		
	Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	1.59E-02	5.39E-03	2.65E-02	1.00E-02	6.88E-02	2.23E-02
1999	1.88E-02	9.74E-03	2.79E-02	1.54E-02	4.24E-02	2.44E-02
2000	2.17E-02	1.40E-02	2.95E-02	1.54E-02	3.63E-02	2.30E-02
2001	2.46E-02	1.80E-02	3.13E-02	1.25E-02	3.76E-02	2.04E-02
2002	2.75E-02	2.16E-02	3.34E-02	6.71E-03	2.85E-02	1.40E-02
2003	3.04E-02	2.48E-02	3.60E-02	1.71E-02	3.98E-02	2.53E-02
2004	3.33E-02	2.74E-02	3.92E-02	3.11E-02	9.47E-02	4.49E-02
2005	3.62E-02	2.95E-02	4.29E-02	2.49E-02	4.40E-02	3.17E-02
2006	3.91E-02	3.13E-02	4.69E-02	2.24E-02	4.51E-02	3.00E-02
2007	4.20E-02	3.29E-02	5.11E-02	3.04E-02	5.97E-02	3.92E-02
2008	4.49E-02	3.43E-02	5.54E-02	4.78E-02	8.85E-02	5.93E-02

Table 16. Plot data for NR TDP unreliability trend. Figure 8

FY	Regression Curve Data Points			Plot Trend Error Bar Points		
	Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	2.06E-02	1.01E-02	3.12E-02	7.39E-03	6.84E-02	2.03E-02
1999	1.99E-02	1.08E-02	2.90E-02	1.90E-02	4.66E-02	2.91E-02
2000	1.91E-02	1.13E-02	2.69E-02	3.76E-03	2.47E-02	1.11E-02
2001	1.84E-02	1.17E-02	2.50E-02	8.49E-03	3.38E-02	1.66E-02
2002	1.76E-02	1.17E-02	2.35E-02	3.24E-03	2.49E-02	1.06E-02
2003	1.68E-02	1.12E-02	2.25E-02	1.44E-02	3.79E-02	2.31E-02
2004	1.61E-02	1.02E-02	2.20E-02	2.53E-03	6.50E-02	1.49E-02
2005	1.53E-02	8.64E-03	2.20E-02	1.39E-02	3.46E-02	2.14E-02
2006	1.45E-02	6.78E-03	2.23E-02	3.26E-03	2.55E-02	1.05E-02
2007	1.38E-02	4.70E-03	2.29E-02	7.76E-03	3.64E-02	1.62E-02
2008	1.30E-02	2.48E-03	2.36E-02	2.45E-03	4.13E-02	1.15E-02

Table 17. Plot data for standby TDP start demands trend. Figure 9

FY	Demands	Reactor Years	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	1649	101.0	1.66E+01	1.59E+01	1.73E+01	1.57E+01	1.70E+01	1.63E+01
1999	1639	101.0	1.62E+01	1.56E+01	1.68E+01	1.56E+01	1.69E+01	1.62E+01
2000	1651	101.3	1.58E+01	1.53E+01	1.63E+01	1.56E+01	1.70E+01	1.63E+01
2001	1530	101.0	1.54E+01	1.50E+01	1.58E+01	1.45E+01	1.58E+01	1.51E+01
2002	1518	101.0	1.50E+01	1.47E+01	1.54E+01	1.44E+01	1.57E+01	1.50E+01
2003	1583	101.0	1.47E+01	1.43E+01	1.50E+01	1.50E+01	1.63E+01	1.57E+01
2004	1395	101.3	1.43E+01	1.40E+01	1.47E+01	1.32E+01	1.44E+01	1.38E+01
2005	1361	101.0	1.40E+01	1.36E+01	1.44E+01	1.29E+01	1.41E+01	1.35E+01
2006	1361	101.0	1.36E+01	1.32E+01	1.41E+01	1.29E+01	1.41E+01	1.35E+01
2007	1346	101.4	1.33E+01	1.28E+01	1.38E+01	1.27E+01	1.39E+01	1.33E+01
2008	1356	102.3	1.30E+01	1.24E+01	1.36E+01	1.27E+01	1.39E+01	1.33E+01

Table 18. Plot data for standby TDP run ≤1-hour run-hours trend. Figure 10

FY	Hours	Reactor Years	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	1649	101.0	1.66E+01	1.59E+01	1.73E+01	1.57E+01	1.70E+01	1.63E+01
1999	1639	101.0	1.62E+01	1.56E+01	1.68E+01	1.56E+01	1.69E+01	1.62E+01
2000	1651	101.3	1.58E+01	1.53E+01	1.63E+01	1.56E+01	1.70E+01	1.63E+01
2001	1530	101.0	1.54E+01	1.50E+01	1.58E+01	1.45E+01	1.58E+01	1.51E+01
2002	1518	101.0	1.50E+01	1.47E+01	1.54E+01	1.44E+01	1.57E+01	1.50E+01
2003	1583	101.0	1.47E+01	1.43E+01	1.50E+01	1.50E+01	1.63E+01	1.57E+01
2004	1395	101.3	1.43E+01	1.40E+01	1.47E+01	1.32E+01	1.44E+01	1.38E+01
2005	1361	101.0	1.40E+01	1.36E+01	1.44E+01	1.29E+01	1.41E+01	1.35E+01
2006	1361	101.0	1.36E+01	1.32E+01	1.41E+01	1.29E+01	1.41E+01	1.35E+01
2007	1346	101.4	1.33E+01	1.28E+01	1.38E+01	1.27E+01	1.39E+01	1.33E+01
2008	1356	102.3	1.30E+01	1.24E+01	1.36E+01	1.27E+01	1.39E+01	1.33E+01

Table 19. Plot data for standby TDP run-hours trend. Figure 11

FY	Run Hours	Reactor Years	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	1416	101.0	2.25E+01	1.46E+01	3.47E+01	1.34E+01	1.46E+01	1.40E+01
1999	3663	101.0	2.09E+01	1.44E+01	3.03E+01	3.53E+01	3.73E+01	3.63E+01
2000	1631	101.3	1.94E+01	1.42E+01	2.67E+01	1.55E+01	1.68E+01	1.61E+01
2001	1673	101.0	1.81E+01	1.37E+01	2.38E+01	1.59E+01	1.72E+01	1.66E+01
2002	2221	101.0	1.68E+01	1.30E+01	2.17E+01	2.12E+01	2.28E+01	2.20E+01
2003	2434	101.0	1.57E+01	1.21E+01	2.03E+01	2.33E+01	2.49E+01	2.41E+01
2004	1308	101.3	1.46E+01	1.09E+01	1.95E+01	1.23E+01	1.35E+01	1.29E+01
2005	1160	101.0	1.35E+01	9.67E+00	1.90E+01	1.09E+01	1.20E+01	1.15E+01
2006	1125	101.0	1.26E+01	8.48E+00	1.87E+01	1.06E+01	1.17E+01	1.11E+01
2007	1083	101.4	1.17E+01	7.39E+00	1.86E+01	1.02E+01	1.12E+01	1.07E+01
2008	1088	102.3	1.09E+01	6.41E+00	1.86E+01	1.01E+01	1.12E+01	1.06E+01

Table 20. Plot data for standby TDP FTS events trend. Figure 12

FY	Failures	Reactor Years	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	5	101.0	8.34E-02	4.51E-02	1.54E-01	2.14E-02	9.21E-02	5.15E-02
1999	16	101.0	8.26E-02	4.86E-02	1.40E-01	9.77E-02	2.22E-01	1.55E-01
2000	16	101.3	8.18E-02	5.20E-02	1.29E-01	9.75E-02	2.21E-01	1.54E-01
2001	5	101.0	8.10E-02	5.49E-02	1.20E-01	2.14E-02	9.21E-02	5.15E-02
2002	4	101.0	8.02E-02	5.67E-02	1.13E-01	1.56E-02	7.92E-02	4.21E-02
2003	9	101.0	7.94E-02	5.69E-02	1.11E-01	4.74E-02	1.41E-01	8.90E-02
2004	10	101.3	7.86E-02	5.53E-02	1.12E-01	5.41E-02	1.53E-01	9.81E-02
2005	8	101.0	7.78E-02	5.22E-02	1.16E-01	4.06E-02	1.29E-01	7.96E-02
2006	6	101.0	7.71E-02	4.84E-02	1.23E-01	2.76E-02	1.05E-01	6.09E-02
2007	8	101.4	7.63E-02	4.43E-02	1.31E-01	4.05E-02	1.29E-01	7.93E-02
2008	9	102.3	7.55E-02	4.02E-02	1.42E-01	4.68E-02	1.39E-01	8.79E-02

Table 21. Plot data for standby TDP FTR≤1H events trend. Figure 13

FY	Failures	Reactor Years	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	2	101.0	4.44E-02	2.36E-02	8.34E-02	5.02E-03	4.85E-02	2.19E-02
1999	5	101.0	4.21E-02	2.45E-02	7.24E-02	2.00E-02	8.62E-02	4.82E-02
2000	6	101.3	4.00E-02	2.52E-02	6.34E-02	2.58E-02	9.78E-02	5.68E-02
2001	6	101.0	3.79E-02	2.54E-02	5.66E-02	2.58E-02	9.80E-02	5.70E-02
2002	3	101.0	3.60E-02	2.50E-02	5.17E-02	9.50E-03	6.16E-02	3.07E-02
2003	7	101.0	3.41E-02	2.38E-02	4.89E-02	3.18E-02	1.10E-01	6.57E-02
2004	3	101.3	3.24E-02	2.19E-02	4.78E-02	9.47E-03	6.15E-02	3.06E-02
2005	3	101.0	3.07E-02	1.97E-02	4.80E-02	9.50E-03	6.16E-02	3.07E-02
2006	1	101.0	2.92E-02	1.73E-02	4.92E-02	1.54E-03	3.42E-02	1.31E-02
2007	4	101.4	2.77E-02	1.50E-02	5.09E-02	1.45E-02	7.39E-02	3.93E-02
2008	2	102.3	2.62E-02	1.30E-02	5.31E-02	4.96E-03	4.80E-02	2.17E-02

Table 22. Plot data for standby TDP FTR>1H events trend. Figure 14

FY	Failures	Reactor Years	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	1	101.0	5.96E-03	2.38E-03	1.50E-02	1.46E-03	3.24E-02	1.24E-02
1999	1	101.0	7.46E-03	3.34E-03	1.67E-02	1.46E-03	3.24E-02	1.24E-02
2000	0	101.3	9.32E-03	4.66E-03	1.87E-02	1.63E-05	1.59E-02	4.14E-03
2001	1	101.0	1.17E-02	6.44E-03	2.11E-02	1.46E-03	3.24E-02	1.24E-02
2002	0	101.0	1.46E-02	8.79E-03	2.42E-02	1.63E-05	1.59E-02	4.15E-03
2003	2	101.0	1.82E-02	1.17E-02	2.83E-02	4.75E-03	4.59E-02	2.07E-02
2004	5	101.3	2.28E-02	1.51E-02	3.43E-02	1.89E-02	8.14E-02	4.55E-02
2005	3	101.0	2.85E-02	1.87E-02	4.34E-02	8.99E-03	5.84E-02	2.90E-02
2006	3	101.0	3.56E-02	2.23E-02	5.69E-02	8.99E-03	5.84E-02	2.90E-02
2007	4	101.4	4.45E-02	2.58E-02	7.68E-02	1.38E-02	7.00E-02	3.72E-02
2008	8	102.3	5.57E-02	2.93E-02	1.06E-01	3.56E-02	1.13E-01	6.98E-02

Table 23. Plot data for normally running TDP start demands trend. Figure 15

FY	Demands	Reactor Years	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	116	101.0	1.13E+00	1.10E+00	1.16E+00	9.79E-01	1.33E+00	1.15E+00
1999	116	101.0	1.13E+00	1.11E+00	1.16E+00	9.79E-01	1.33E+00	1.15E+00
2000	115	101.3	1.14E+00	1.11E+00	1.17E+00	9.68E-01	1.31E+00	1.14E+00
2001	113	101.0	1.14E+00	1.12E+00	1.17E+00	9.52E-01	1.30E+00	1.12E+00
2002	116	101.0	1.15E+00	1.13E+00	1.17E+00	9.79E-01	1.33E+00	1.15E+00
2003	118	101.0	1.15E+00	1.14E+00	1.17E+00	9.98E-01	1.35E+00	1.17E+00
2004	117	101.3	1.16E+00	1.14E+00	1.18E+00	9.86E-01	1.34E+00	1.16E+00
2005	115	101.0	1.17E+00	1.14E+00	1.19E+00	9.70E-01	1.32E+00	1.14E+00
2006	114	101.0	1.17E+00	1.14E+00	1.20E+00	9.61E-01	1.31E+00	1.13E+00
2007	122	101.4	1.18E+00	1.15E+00	1.21E+00	1.03E+00	1.39E+00	1.20E+00
2008	124	102.3	1.18E+00	1.15E+00	1.22E+00	1.04E+00	1.40E+00	1.21E+00

Table 24. Plot data for normally running TDP run hours trend. Figure 16

FY	Run Hours	Reactor Years	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	445800	101.0	4.42E+03	4.40E+03	4.44E+03	4.40E+03	4.42E+03	4.41E+03
1999	445800	101.0	4.42E+03	4.40E+03	4.44E+03	4.40E+03	4.42E+03	4.41E+03
2000	445800	101.3	4.42E+03	4.40E+03	4.43E+03	4.39E+03	4.41E+03	4.40E+03
2001	446347	101.0	4.41E+03	4.40E+03	4.43E+03	4.41E+03	4.43E+03	4.42E+03
2002	446535	101.0	4.41E+03	4.40E+03	4.42E+03	4.41E+03	4.43E+03	4.42E+03
2003	446532	101.0	4.41E+03	4.40E+03	4.42E+03	4.41E+03	4.43E+03	4.42E+03
2004	446530	101.3	4.41E+03	4.40E+03	4.42E+03	4.40E+03	4.42E+03	4.41E+03
2005	446528	101.0	4.41E+03	4.39E+03	4.42E+03	4.41E+03	4.43E+03	4.42E+03
2006	446528	101.0	4.40E+03	4.39E+03	4.42E+03	4.41E+03	4.43E+03	4.42E+03
2007	446537	101.4	4.40E+03	4.38E+03	4.42E+03	4.40E+03	4.42E+03	4.41E+03
2008	446530	102.3	4.40E+03	4.38E+03	4.42E+03	4.36E+03	4.38E+03	4.37E+03

Table 25. Plot data for normally running TDP FTS events trend. Figure 17

FY	Failures	Reactor Years	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	1	101.0	1.01E-02	3.48E-03	2.91E-02	1.14E-03	2.54E-02	9.74E-03
1999	3	101.0	9.36E-03	3.75E-03	2.33E-02	7.04E-03	4.57E-02	2.27E-02
2000	0	101.3	8.70E-03	3.99E-03	1.90E-02	1.27E-05	1.24E-02	3.24E-03
2001	1	101.0	8.09E-03	4.13E-03	1.59E-02	1.14E-03	2.54E-02	9.74E-03
2002	0	101.0	7.53E-03	4.13E-03	1.37E-02	1.28E-05	1.25E-02	3.25E-03
2003	2	101.0	7.00E-03	3.92E-03	1.25E-02	3.72E-03	3.59E-02	1.62E-02
2004	0	101.3	6.51E-03	3.52E-03	1.20E-02	1.27E-05	1.24E-02	3.24E-03
2005	2	101.0	6.05E-03	3.01E-03	1.21E-02	3.72E-03	3.59E-02	1.62E-02
2006	0	101.0	5.63E-03	2.50E-03	1.27E-02	1.28E-05	1.25E-02	3.25E-03
2007	1	101.4	5.23E-03	2.02E-03	1.35E-02	1.14E-03	2.53E-02	9.72E-03
2008	0	102.3	4.87E-03	1.62E-03	1.46E-02	1.27E-05	1.24E-02	3.22E-03

Table 26. Plot data for normally running TDP FTR events trend. Figure 18

FY	Failures	Reactor Years	Regression Curve Data Points			Plot Trend Error Bar Points		
			Mean	Lower (5%)	Upper (95%)	Lower (5%)	Upper (95%)	Mean
1998	3	101.0	4.39E-02	2.30E-02	8.37E-02	9.52E-03	6.18E-02	3.08E-02
1999	6	101.0	4.18E-02	2.40E-02	7.29E-02	2.59E-02	9.83E-02	5.71E-02
2000	6	101.3	3.99E-02	2.48E-02	6.41E-02	2.58E-02	9.80E-02	5.70E-02
2001	2	101.0	3.80E-02	2.53E-02	5.73E-02	5.03E-03	4.86E-02	2.20E-02
2002	3	101.0	3.63E-02	2.50E-02	5.25E-02	9.52E-03	6.18E-02	3.08E-02
2003	3	101.0	3.46E-02	2.40E-02	4.98E-02	9.52E-03	6.18E-02	3.08E-02
2004	9	101.3	3.30E-02	2.22E-02	4.89E-02	4.43E-02	1.32E-01	8.33E-02
2005	4	101.0	3.14E-02	2.00E-02	4.94E-02	1.46E-02	7.43E-02	3.95E-02
2006	3	101.0	3.00E-02	1.77E-02	5.09E-02	9.52E-03	6.18E-02	3.08E-02
2007	1	101.4	2.86E-02	1.54E-02	5.30E-02	1.54E-03	3.42E-02	1.31E-02
2008	3	102.3	2.73E-02	1.33E-02	5.57E-02	9.42E-03	6.11E-02	3.04E-02

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