Results and Databases Trend Summary

2013

1 INTRODUCTION

This report presents a summary of reliability and frequency trends reported in several separate reports available on the NRC Operating Experience web site. Each report lists the significant[1], either increasing or decreasing, trends identified in each report and this report puts those trends in a single location. The figure numbers of significant trends are the figure number in the referenced report. This report does not estimate values for use in probabilistic risk assessments (PRAs), but does evaluate performance over time.

The trend evaluations in the Component Performance and System studies are based on the operating experience reports from fiscal year (FY) 1998 through FY 2013 as they are collected in the Integrated Data Collection and Calculation System (IDCCS). The loss of offsite power (LOOP, calendar year 1986 to 2013) and initiating event (IE, FY 1988 to FY 2013) studies also use IDCCS data. 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.

2 COMPONENT PERFORMANCE

Important Trends and Observations:

- *The EPS, industry-wide EDG unreliability trend is extremely statistically significant and increasing. This trend shows no sign of changing in the next few years.*
- *The EPS EDG FTR>1H trend is highly statistically significant and increasing. This trend shows no sign of changing in the next few years.*

2.1 Air-Operated Valves

No statistically significant trends were identified in this update in the air-operated valve data.

2.2 Emergency Diesel Generators

In this update, the following extremely statistically significant increasing trends were identified in the EDG results:

- EPS, industry-wide EDG unreliability trend (8-hour mission). (see Figure 9)

[1] Statistical significance 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).

Highly statistically significant increasing trends were identified in the EDG results:

- Failure rate estimate trend for EPS EDGs, industry-wide EDG FTR>1H trend. (see Figure 3)

Highly statistically significant decreasing trends were identified in the EDG results for the following:

- Frequency (events per reactor year) of start demands, EPS and HPCS EDGs. (see Figure 11)
- EPS and HPCS EDG run hours per reactor year. (see Figure 13)

Statistically significant decreasing trends were identified in the EDG results:

- Frequency (events per reactor year) of load and run ≤ 1 hour demands, EPS and HPCS EDGs (see Figure 12).

2.3 Motor-Driven Pumps

In this update, the following statistically significant increasing trends were identified in the MDP results.

- Standby MDP run hours per reactor critical year. (see Figure 11)

This trend is not an adverse trend; it only indicates an increase in run hours for standby pumps. Standby MDP run hours appear to have made a step change in the upward direction in FY 2002 and FY 2003, which coincides with the start of the MSPI program. This influences an increasing trend over the 2003 to 2013 period.

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

- Standby systems, industry-wide MDP frequency of start demands (see Figure 9)
- Standby systems, industry-wide MDP run hours per reactor year for runs of ≤ 1 hour (see Figure 10)
- Frequency (failures per reactor year) of FTS events, standby MDPs. (see Figure 12)

2.4 Motor-Operated Valves

Highly statistically significant increasing trends were identified in the MOV data for the following:

- Failure rate estimate trend for MOV SO, all systems, industry-wide trend of MOVs with > 20 demands per year (see Figure 6).
- Frequency (failures per reactor year) of MOV SO events > 20 demands per year (see Figure 14).

Extremely statistically significant decreasing trends were identified for:

- Frequency (demands per reactor year) of MOV FTOC demands, > 20 demands per year (see Figure 8).

Statistically significant decreasing trends were identified in the MOV data for the following:

- Frequency (demands per reactor year) of MOV FTOC demands, ≤ 20 demands per year (see Figure 7).

2.5 Turbine-Driven Pumps

Highly statistically significant increasing trends were identified in the TDP results for the following:

- TDP unavailability (Figure 6).
- Start demands for standby TDPs (Figure 9).
- Run hours for the first hour for standby TDPs (Figure 10).

Figures 9 and 10 are providing essentially the same information since each start demand is assumed to result in the accumulation of one hour towards the exposure for FTR≤1H.

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

- Frequency (events per reactor year) of start demands, normally running TDPs. (see Figure 15)
- Normally running TDP run hours per reactor critical year. (see Figure 16)

Both of these decreasing trends are only significant because of the consistent (lack of variation) values year-to-year. The actual decrease is less than 5% for both trends over the most recent 10-year period.

3 LOSS OF OFFSITE POWER EVENTS

None of the loss of offsite power (LOOP) initiating event frequency trend plots show statistically significant trends.

The 1997–2013 LOOP durations exhibit a significant increasing trend, driven by the grid- and switchyard-based events. The results of this trending analysis are presented in Figure 8. The detailed results for the grid- and switchyard-based events are present in Figures 9 and 10. No significant trends in plant-centered or weather-related durations since 1997 were found.

4 RATES OF INITIATING EVENTS

The results of occurrence rates for the categories of initiating events summarized in this section. Sixteen initiating event groupings are trended and displayed. Note that the LOOP trend presented here is the trend of all LOOP categories.

Highly statistically significant decreasing trends were identified for the following:

- Loss of main feedwater. (see Figure 6)

Table 1. Summary of initiating event trend figures.

Figure	Description	p-value	Trend Direction	Trend Significance[2]
1	LOOP - Loss of Offsite Power	0.078	--	
2	LOAC - Loss of AC Power	0.210	--	
3	LODC - Loss of DC Power	0.420	--	
4	VSLOCA – Very Small Loss of Coolant Accident	0.340	--	
5	PLOCCW - Partial Loss of Component Cooling Water	0.600	--	
6	LOMFW - Loss of Main Feedwater	0.003	decreasing	High
7	PLOSWS - Partial Loss of Service Water System	1.000	--	
8	LOIA (BWR) - Loss of Instrument Air (BWR)	0.430	--	
9	SORV (BWR) - Stuck Open Relief Valve (BWR)	0.350	--	
10	LOCHS (BWR) - Loss of Condensed Heat Sink (BWR)	0.097	--	
11	TRANS (BWR) - Transients (BWR)	0.160	--	
12	LOIA (PWR) - Loss of Instrument Air (PWR)	0.640	--	
13	SGTR (PWR) - Steam Generator Tube Rupture (PWR)	1.000	--	
14	SORV (PWR) - Stuck Open Relief Valve (PWR)	1.000	--	
15	LOCHS (PWR) - Loss of Condenser Heat Sink (PWR)	0.097	--	
16	TRANS (PWR) - Transients (PWR)	0.790	--	

5 SYSTEM STUDIES

5.1 Auxiliary Feedwater System

No statistically significant trends were identified in the auxiliary feedwater system results.

5.2 Emergency Power System

No statistically significant trends were identified in the emergency power system results.

5.3 High Pressure Coolant Injection

No statistically significant trends were identified in the high pressure coolant injection results.

5.4 High Pressure Core Spray

No statistically significant trends were identified in the high pressure core spray results.

[2] Statistical significance 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).

5.5 High Pressure Safety Injection

No statistically significant trends were identified in the high pressure safety injection results.

5.6 Isolation Condenser

No statistically significant trends were identified in the isolation condenser results.

5.7 Reactor Core Isolation Cooling

No statistically significant trends were identified in the reactor core isolation cooling results.

5.8 Residual Heat Removal System

No statistically significant trends were identified in the residual heat removal system results.