Results and Databases Trend Summary

2018

1 INTRODUCTION

The following is a summary of the reliability and frequency trends identified in the update reports provided on the NRC Operating Experience web site. The statistically significant[1], either increasing or decreasing, trends identified in each update report are provided here in a single location. The figure numbers called out for the significant trends are the figure numbers in the separate update reports. Starting with 2016 update year the frequency of the component and system performance updates is shifting to every other year. The loss of offsite power (LOOP) and initiating event updates continue to be annual.

2 COMPONENT PERFORMANCE

The component performance study was last updated using data from 1998 through 2018. The summary provided in this section is therefore the latest available information until the next update, which is scheduled for completion when the 2020 data are available.

The trending analysis in the study used data over the last 10 years, i.e., from 2009 through 2018. Important trends and observations from the analysis are presented below:

- *The failure probability estimate trend for MOVs to open or close for low-demand valves (those with less than or equal to twenty demands per reactor year) is highly statistically significant and decreasing. This trend shows no sign of changing as it was also existing in previous component performance analyses using data from 1998 through 2014 and from 1998 through 2016.*

- *The unavailability trend for standby MDPs is highly statistically significant and decreasing. This is a new trend that was not existing in the last component performance analysis using data from 1998 through 2016.*

- *The failure rate estimate trend for normally running MDPs to run is statistically significant and decreasing. This is a new trend that was not existing in the last component performance analysis using data from 1998 through 2016.*

[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).

- *The unreliability (8-hour mission) trend for standby MDPs is statistically significant and decreasing. This is a new trend that was not existing in the last component performance analysis using data from 1998 through 2016.*

- *The unavailability trend for standby TDPs is highly statistically significant and decreasing. This is a new trend that was not existing in the last component performance analysis using data from 1998 through 2016.*

2.1 Air-Operated Valves

2.1.1 Increasing Trends

2.1.1.1 Extremely Statistically Significant

- The frequency of demands per reactor year for AOVs to open or close for high-demand valves (those with greater than twenty demands per reactor year) was found to be increasing.

2.1.1.2 Highly Statistically Significant

- The frequency of demands per reactor year for AOVs to open or close for low-demand valves (those with less than or equal to twenty demands per reactor year) was found to be increasing.

2.1.2 Decreasing Trends

- None.

2.2 Emergency Diesel Generators

2.2.1 Increasing Trends

2.2.1.1 Statistically Significant

- The frequency of demands per reactor year for EPS and HPCS EDGs to load and run was found to be increasing.

2.2.2 Decreasing Trends

2.2.2.1 Statistically Significant

- EPS and HPCS EDG run hours per reactor year were found to be decreasing.

2.3 Motor-Driven Pumps

2.3.1 Increasing Trends

2.3.1.1 Extremely Statistically Significant

- Normally running MDP run hours per reactor critical year were found to be increasing.

2.3.2 Decreasing Trends

2.3.2.1 Highly Statistically Significant

- The standby MDP unavailability was found to be decreasing.

2.3.2.2 Statistically Significant

- The failure rate for normally running MDPs to run was found to be decreasing.
- The standby MDP unreliability (8-hour mission) was found to be decreasing.
- The frequency of fail to run events (events per reactor year) for normally running MDPs was found to be decreasing.

2.4 Motor-Operated Valves

2.4.1 Increasing Trends

2.4.1.1 Highly Statistically Significant

- The frequency of demands per reactor year for MOVs to open or close for low-demand valves (those with less than or equal to twenty demands per reactor year) was found to be increasing.

2.4.2 Decreasing Trends

2.4.2.1 Highly Statistically Significant

- The failure probability for MOVs to open or close for low-demand valves (those with less than or equal to twenty demands per reactor year) was found to be decreasing.
- The frequency of failure to open or close events (events per reactor year) for low-demand MOVs (those with less than or equal to twenty demands per reactor year) was found to be decreasing.

2.5 Turbine-Driven Pumps

2.5.1 Increasing Trends

- None.

2.5.2 Decreasing Trends

2.5.2.1 Highly Statistically Significant

- The standby TDP unavailability was found to be decreasing.

3 LOSS OF OFFSITE POWER EVENTS

There were no statistically significant1 10-year trends identified in critical operation LOOP frequencies for all LOOP categories or any of the four LOOP categories over the 2009-2018 period.

The 1997–2018 post-deregulation LOOP durations exhibited an extremely significant increasing trend, driven by the switchyard- and grid-based events.

4 RATES OF INITIATING EVENTS

The trend in occurrence rates for the categories of initiating events are summarized in this section. Sixteen initiating event categories are trended and displayed. Note that the LOOP trend presented here is the trend for all LOOP categories combined, and include only initiating events, whereas the events considered in the LOOP study above are all events during critical operation.

Table 1 summarizes the p-values for each initiating event category. No statistically significant trends were identified for the most recent 10 year period (from 2009 through 2018).

Table 1. Summary of initiating event trend figures.

Figure	Description	p-value	Trend Direction	Trend Significance
1	LOOP - Loss of Offsite Power	0.197	--	
2	LOAC - Loss of AC Power	0.556	--	
3	LODC - Loss of DC Power	0.369	--	
4	VSLOCA – Very Small Loss of Coolant Accident	1.000	--	
5	PLOCCW - Partial Loss of Component Cooling Water	0.180	--	
6	LOMFW - Loss of Main Feedwater	0.860	--	
7	PLOSWS - Partial Loss of Service Water System	1.000	--	
8	LOIA (BWR) - Loss of Instrument Air (BWR)	0.447	--	
9	SORV (BWR) - Stuck Open Relief Valve (BWR)	1.000	--	
10	LOCHS (BWR) - Loss of Condensed Heat Sink (BWR)	0.872	--	
11	TRANS (BWR) - Transients (BWR)	0.085	--	
12	LOIA (PWR) - Loss of Instrument Air (PWR)	0.370	--	
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)	0.125	--	
16	TRANS (PWR) - Transients (PWR)	0.003	Decreasing	Highly Significant

5 SYSTEM STUDIES

The system performance study was last updated using data from 1998 through 2018. The summary provided in this section is therefore the latest available information until the next update, which is scheduled for completion when the 2020 data are available.

The trending analysis in the study used data over the most recent 10 years, i.e., from 2009 through 2018. No statistically significant decreasing trends were identified from the analysis.

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.

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.