CCF Parameter Estimations 2012

U.S. Nuclear Regulatory Commission, "CCF Parameter Estimations, 2012 Update"

This report documents the quantitative results of the common-cause failure (CCF) data collection effort and summarizes the results of the parameter estimation quantification process, performed on CCF data in the U.S. NRC CCF database.

11/11/2013

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This report documents the quantitative results of the common-cause failure (CCF) data collection effort and summarizes the results of the parameter estimation quantification process, performed on CCF data in the U.S. NRC CCF database.

These results are appropriate for use in Probabilistic Risk Assessment studies of commercial nuclear power plants in the U.S.

Included in these results are the applications to be used in the SPAR Version greater than 3.45 models. This is the 2012 update to NUREG/CR-5496, updating data and parameter estimations.

This release, CCF Parameter Estimation for 2012, reflects the CCF data contained within the CCF database, Version 4.5.2012. This version of the CCF database contains data from 1997 to 2012.

The applications contained within were created with a starting date of 1/1/1997. This date was selected in order to use as much of the CCF data as possible, but to avoid using the large number of CCF events in the 1980 to 1996 period since the trend is decreasing significantly from 1980 to 1996.

The way to provide a reference for this update is:

U.S. Nuclear Regulatory Commission, "CCF Parameter Estimations, 2012 Update", http://nrcoe.inl.gov/results/CCF/ParamEst2012/ccfparamest.htm, November 2013.

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General CCF Information

A general conclusion from probabilistic risk assessments (PRAs) of commercial nuclear power plants is that common cause failures (CCFs) are significant contributors to the unavailability of safety systems. A CCF event consists of component failures that meet the following four criteria: (1) two or more components fail or are degraded at the same plant and in the same system, (2) component failures occur within a selected period of time such that success of the PRA mission would be uncertain, (3) the component failures result from a single shared cause and are linked by a coupling mechanism such that other components in the group are susceptible to the same cause and failure mode and, (4) the equipment failures are not caused by the failure of equipment outside the established component boundary.

In response to these deficiencies, the Idaho National Laboratory (INL) staff and the Nuclear Regulatory Commission's (NRC) Office of Nuclear Regulatory Research have developed a CCF data collection and analysis system that includes a method for identifying CCF events, coding and classifying those events for use in CCF studies, and a computer system for storing and analyzing the data. The system is based, in part, on previous CCF methods and models and is designed to run on a personal computer (PC). The data collection effort has collected CCF events from 1980 through 2012 for use in CCF analyses. The current data collection effort has separated the data by system. The principal products of this CCF data collection and analysis system (CCF database) are the method for identifying and classifying CCF events, the CCF database containing both CCF events and independent failure counts, and the CCF parameter estimation software.

Three data sources are used to select equipment failure reports to be reviewed for CCF event identification: the Nuclear Plant Reliability Data System (NPRDS), which contained component failure information prior to 1997; the Equipment Performance and Information Exchange (EPIX), which contains component failure information since 1997; and the Sequence Coding and Search System (SCSS), which

contains Licensee Event Reports (LERs). All events that meet the above criteria are identified as CCF events and included in the CCF database.

1 Industry Component CCF Distributions

This section contains CCF applications created for components pooled at various levels. The first level presented is the industry-wide component specific pooled distribution. The pooled distribution represents the pooling of the more specific distributions shown under the pooled distribution. Typically, the pooling takes place across systems.

It is up to the user to decide the level of pooling that is appropriate to the intended use. If data exist at the system/component level most appropriate to the intended use, and are not sparse, it is recommended to use the more specific data. Otherwise, it is recommended to use the industry level pooled component data. If no pooled components are listed that are similar to the intended use, the use of the No Data (Prior Only) pooled distribution may be appropriate.

1.1 General CCF Information

A general conclusion from probabilistic risk assessments (PRAs) of commercial nuclear power plants is that common cause failures (CCFs) are significant contributors to the unavailability of safety systems. A CCF event consists of component failures that meet the following four criteria: (1) two or more components fail or are degraded at the same plant and in the same system, (2) component failures occur within a selected period of time such that success of the PRA mission would be uncertain, (3) the component failures result from a single shared cause and are linked by a coupling mechanism such that other components in the group are susceptible to the same cause and failure mode and, (4) the equipment failures are not caused by the failure of equipment outside the established component boundary.

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Three data sources are used to select equipment failure reports to be reviewed for CCF event identification: the Nuclear Plant Reliability Data System (NPRDS), which contained component failure information prior to 1997; the Equipment Performance and Information Exchange (EPIX), which contains component failure information since 1997; and the Sequence Coding and Search System (SCSS), which contains Licensee Event Reports (LERs). All events that meet the above criteria are identified as CCF events and included in the CCF database.

1.2 Industry Component CCF Introduction

This section contains CCF applications created for components pooled at various levels. The first level presented is the industry-wide component specific pooled distribution. The pooled distribution represents the pooling of the more specific distributions shown under the pooled distribution. Typically, the pooling takes place across systems.

It is up to the user to decide the level of pooling that is appropriate to the intended use. If data exist at the system/component level most appropriate to the intended use, and are not sparse, it is recommended to use the more specific data. Otherwise, it is recommended to use the industry level pooled component data. If no pooled components are listed that are similar to the intended use, the use of the Generic Demand, Generic Rate, or the No Data (Prior Only) pooled distribution may be appropriate.

This update to the parameter estimation report includes the SPAR alpha factor basic event name to facilitate the cross reference of this report to the SPAR models. The SPAR basic event name can be found in the title of the application report and in the topic text if SPAR uses the parameter estimate.

1.3 Motor Driven Pumps

1.3.1 Pooled Motor Driven Pump Distributions

1.3.1.1 MOTOR DRIVEN PUMP FAIL TO START ALL SYSTEMS SPAR: MDP-FS

Component : Motor Driven Pump
Failure Mode : Fail to start
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 591.90
Total Number of Common-Cause Failure Events: 23

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9629110	0.9763970	0.9771690	0.9872580	0.9768530	4.0072E+02	9.6868E+00
α_2	1.27E-02	2.36E-02	2.28E-02	3.71E-02	2.31E-02	9.6868E+00	4.0072E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9669330	0.9774850	0.9779960	0.9863010	0.9781770	6.0973E+02	1.4045E+01
α_2	6.83E-03	1.34E-02	1.29E-02	2.18E-02	1.27E-02	8.3706E+00	6.1540E+02
α_3	3.86E-03	9.10E-03	8.58E-03	1.61E-02	9.12E-03	5.6739E+00	6.1810E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9685530	0.9775830	0.9779660	0.9853160	0.9785750	8.1453E+02	1.8678E+01
α_2	6.98E-03	1.26E-02	1.22E-02	1.95E-02	1.18E-02	1.0495E+01	8.2271E+02
α_3	2.57E-03	6.32E-03	5.93E-03	1.14E-02	6.19E-03	5.2679E+00	8.2794E+02
α_4	9.31E-04	3.50E-03	3.11E-03	7.39E-03	3.43E-03	2.9155E+00	8.3029E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9724880	0.9799750	0.9802690	0.9864550	0.9815520	1.0552E+03	2.1563E+01
α_2	4.62E-03	8.71E-03	8.40E-03	1.38E-02	7.43E-03	9.3749E+00	1.0674E+03
α_3	2.84E-03	6.18E-03	5.88E-03	1.06E-02	5.81E-03	6.6546E+00	1.0701E+03
α_4	1.33E-03	3.82E-03	3.52E-03	7.34E-03	3.83E-03	4.1161E+00	1.0726E+03
α_5	1.40E-04	1.32E-03	1.02E-03	3.49E-03	1.38E-03	1.4170E+00	1.0753E+03

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9753190	0.9818310	0.9820760	0.9874960	0.9836070	1.2664E+03	2.3435E+01
α_2	3.30E-03	6.50E-03	6.24E-03	1.06E-02	5.25E-03	8.3787E+00	1.2815E+03
α_3	2.35E-03	5.13E-03	4.88E-03	8.78E-03	4.69E-03	6.6207E+00	1.2832E+03
α_4	1.49E-03	3.82E-03	3.56E-03	7.01E-03	3.71E-03	4.9226E+00	1.2849E+03
α_5	5.40E-04	2.14E-03	1.89E-03	4.59E-03	2.17E-03	2.7582E+00	1.2871E+03
α_6	1.33E-05	5.86E-04	3.56E-04	1.94E-03	5.75E-04	7.5524E-01	1.2891E+03

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9768530	0.9781770	0.9785750	0.9815520	0.9836070
α_2	2.31E-02	1.27E-02	1.18E-02	7.43E-03	5.25E-03
α_3		9.12E-03	6.19E-03	5.81E-03	4.69E-03
α_4			3.43E-03	3.83E-03	3.71E-03
α_5				1.38E-03	2.17E-03
α_6					5.75E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.77E-01	9.78E-01	9.79E-01	9.82E-01	9.84E-01
Beta	2.31E-02	2.18E-02	2.14E-02	1.84E-02	1.64E-02
Gamma		4.18E-01	4.49E-01	5.97E-01	6.80E-01
Delta			3.56E-01	4.73E-01	5.79E-01
Epsilon				2.64E-01	4.26E-01
Mu					2.09E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	378.21	567.32	756.42	945.53	1134.63
N_1	12.2620	12.8561	11.9692	13.4597	14.7926
N_2	9.2523	7.5369	9.2664	7.2607	6.1395
N_3		5.4067	4.8636	5.6772	5.4789
N_4			2.6928	3.7417	4.3304
N_5				1.3447	2.5360
N_6					0.6720

1.3.1.2 MOTOR DRIVEN PUMP FTR LESS THAN 1H ALL SYSTEMS

Component : Motor Driven Pump
Failure Mode : Fail to Run less than 1 Hour
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 46.70
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9041470	0.9597260	0.9661570	0.9932680	0.9598480	4.4509E+01	1.8678E+00
α_2	6.73E-03	4.03E-02	3.38E-02	9.59E-02	4.02E-02	1.8678E+00	4.4509E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9186640	0.9592980	0.9629390	0.9874800	0.9564970	7.9685E+01	3.3809E+00
α_2	7.62E-03	3.13E-02	2.77E-02	6.77E-02	3.38E-02	2.6037E+00	8.0462E+01
α_3	2.36E-04	9.36E-03	5.82E-03	3.05E-02	9.73E-03	7.7722E-01	8.2289E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9183080	0.9539150	0.9564870	0.9807190	0.9487260	1.1132E+02	5.3781E+00
α_2	1.17E-02	3.40E-02	3.13E-02	6.52E-02	3.98E-02	3.9641E+00	1.1273E+02
α_3	3.56E-04	8.06E-03	5.48E-03	2.46E-02	7.80E-03	9.4031E-01	1.1576E+02
α_4	1.20E-05	4.06E-03	1.77E-03	1.59E-02	3.65E-03	4.7367E-01	1.1622E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9340700	0.9601740	0.9618240	0.9806330	0.9550830	1.7727E+02	7.3529E+00
α_2	8.45E-03	2.33E-02	2.16E-02	4.40E-02	2.58E-02	4.3015E+00	1.8032E+02
α_3	2.16E-03	1.14E-02	9.66E-03	2.64E-02	1.32E-02	2.1001E+00	1.8252E+02
α_4	9.25E-05	4.08E-03	2.49E-03	1.35E-02	4.47E-03	7.5389E-01	1.8387E+02
α_5	9.07E-10	1.07E-03	1.07E-04	5.53E-03	1.47E-03	1.9738E-01	1.8443E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9390060	0.9621180	0.9634990	0.9805250	0.9590190	2.1388E+02	8.4212E+00
α_2	6.66E-03	1.88E-02	1.74E-02	3.58E-02	1.91E-02	4.1747E+00	2.1813E+02
α_3	2.44E-03	1.09E-02	9.49E-03	2.43E-02	1.27E-02	2.4265E+00	2.1987E+02
α_4	4.23E-04	5.41E-03	4.01E-03	1.51E-02	6.03E-03	1.2016E+00	2.2110E+02
α_5	6.18E-06	2.13E-03	9.21E-04	8.33E-03	2.48E-03	4.7270E-01	2.2183E+02
α_6	3.35E-12	6.56E-04	2.45E-05	3.63E-03	6.18E-04	1.4574E-01	2.2216E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9598480	0.9564970	0.9487260	0.9550830	0.9590190
α_2	4.02E-02	3.38E-02	3.98E-02	2.58E-02	1.91E-02
α_3		9.73E-03	7.80E-03	1.32E-02	1.27E-02
α_4			3.65E-03	4.47E-03	6.03E-03
α_5				1.47E-03	2.48E-03
α_6					6.18E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.60E-01	9.56E-01	9.49E-01	9.55E-01	9.59E-01
Beta	4.02E-02	4.35E-02	5.13E-02	4.49E-02	4.10E-02
Gamma		2.24E-01	2.23E-01	4.27E-01	5.33E-01
Delta			3.19E-01	3.10E-01	4.18E-01
Epsilon				2.48E-01	3.39E-01
Mu					2.00E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	31.13	46.70	62.27	77.83	93.40
N_1	3.1333	3.4300	2.9160	3.2805	3.5429
N_2	1.4333	1.7700	2.7360	2.1873	1.9355
N_3		0.5100	0.5360	1.1227	1.2847
N_4			0.2510	0.3795	0.6094
N_5				0.1251	0.2505
N_6					0.0625

1.3.1.3 MOTOR DRIVEN PUMP FAIL TO RUN >1H ALL SYSTEMS

Component :	Motor Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment)
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 141.50
Total Number of Common-Cause Failure Events: 11

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9320260	0.9674830	0.9709050	0.9912260	0.9685890	8.6557E+01	2.9092E+00
α_2	8.78E-03	3.25E-02	2.91E-02	6.80E-02	3.14E-02	2.9092E+00	8.6557E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9290810	0.9590350	0.9611150	0.9818940	0.9576980	1.4039E+02	5.9967E+00
α_2	1.35E-02	3.39E-02	3.18E-02	6.15E-02	3.57E-02	4.9653E+00	1.4142E+02
α_3	3.93E-04	7.05E-03	4.97E-03	2.08E-02	6.60E-03	1.0314E+00	1.4536E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9333410	0.9587240	0.9602460	0.9789140	0.9578970	1.9190E+02	8.2620E+00
α_2	1.05E-02	2.58E-02	2.43E-02	4.65E-02	2.59E-02	5.1672E+00	1.9499E+02
α_3	3.17E-03	1.31E-02	1.15E-02	2.84E-02	1.46E-02	2.6203E+00	1.9754E+02
α_4	7.04E-06	2.37E-03	1.03E-03	9.27E-03	1.65E-03	4.7447E-01	1.9969E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9438160	0.9635830	0.9646540	0.9797030	0.9630930	2.7768E+02	1.0495E+01
α_2	7.60E-03	1.85E-02	1.74E-02	3.31E-02	1.70E-02	5.3241E+00	2.8285E+02
α_3	3.30E-03	1.13E-02	1.01E-02	2.30E-02	1.20E-02	3.2423E+00	2.8493E+02
α_4	8.82E-04	6.01E-03	4.91E-03	1.49E-02	7.20E-03	1.7306E+00	2.8644E+02
α_5	5.89E-10	6.86E-04	6.90E-05	3.55E-03	6.65E-04	1.9758E-01	2.8798E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9484840	0.9658960	0.9667940	0.9802580	0.9665400	3.3409E+02	1.1796E+01
α_2	5.94E-03	1.48E-02	1.39E-02	2.68E-02	1.28E-02	5.1147E+00	3.4077E+02
α_3	2.85E-03	9.57E-03	8.64E-03	1.95E-02	9.65E-03	3.3089E+00	3.4258E+02
α_4	1.23E-03	6.26E-03	5.34E-03	1.44E-02	7.00E-03	2.1647E+00	3.4372E+02
α_5	1.83E-04	3.07E-03	2.18E-03	8.99E-03	3.74E-03	1.0619E+00	3.4482E+02
α_6	2.15E-12	4.21E-04	1.57E-05	2.33E-03	2.78E-04	1.4574E-01	3.4574E+02

ALPHA FACTOR and MGL PARAMETERS

MOTOR DRIVEN PUMP FAIL TO RUN ALL SYSTEMS SPAR: MDP-FR

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9685890	0.9576980	0.9578970	0.9630930	0.9665400
α_2	3.14E-02	3.57E-02	2.59E-02	1.70E-02	1.28E-02
α_3		6.60E-03	1.46E-02	1.20E-02	9.65E-03
α_4			1.65E-03	7.20E-03	7.00E-03
α_5				6.65E-04	3.74E-03
α_6					2.78E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.69E-01	9.58E-01	9.58E-01	9.63E-01	9.67E-01
Beta	3.14E-02	4.23E-02	4.21E-02	3.69E-02	3.35E-02
Gamma		1.56E-01	3.85E-01	5.39E-01	6.17E-01
Delta			1.02E-01	3.95E-01	5.33E-01
Epsilon				8.46E-02	3.65E-01
Mu					6.93E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	70.75	106.13	141.50	176.88	212.25
N_1	5.5607	4.7095	4.2643	4.6435	4.8991
N_2	2.4747	4.1316	3.9391	3.2099	2.8755
N_3		0.7642	2.2160	2.2649	2.1671
N_4			0.2518	1.3562	1.5725
N_5				0.1253	0.8397
N_6					0.0625

1.3.1.4 MOTOR DRIVEN PUMP FAIL TO RUN ALL SYSTEMS SPAR: MDP-FR

Component : Motor Driven Pump
Failure Mode : Fail to Run >1 Hour (Standby equipment)
Fail to Run less than 1 Hour
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 188.20
Total Number of Common-Cause Failure Events: 15

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9344420	0.9650340	0.9675020	0.9871770	0.9655720	1.1985E+02	4.3425E+00
α_2	1.28E-02	3.50E-02	3.25E-02	6.56E-02	3.44E-02	4.3425E+00	1.1985E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9322980	0.9580580	0.9596010	0.9785540	0.9569500	1.8906E+02	8.2767E+00
α_2	1.59E-02	3.41E-02	3.26E-02	5.77E-02	3.54E-02	6.7353E+00	1.9060E+02
α_3	9.63E-04	7.81E-03	6.22E-03	2.01E-02	7.64E-03	1.5414E+00	1.9580E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9334460	0.9558490	0.9569820	0.9743780	0.9546440	2.5514E+02	1.1785E+01
α_2	1.48E-02	2.96E-02	2.84E-02	4.84E-02	3.05E-02	7.9032E+00	2.5902E+02
α_3	3.39E-03	1.18E-02	1.06E-02	2.43E-02	1.26E-02	3.1563E+00	2.6377E+02
α_4	5.39E-05	2.72E-03	1.62E-03	9.12E-03	2.30E-03	7.2547E-01	2.6620E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9436620	0.9613960	0.9622260	0.9763010	0.9602510	3.5636E+02	1.4309E+01
α_2	9.88E-03	2.03E-02	1.94E-02	3.36E-02	1.99E-02	7.5115E+00	3.6316E+02
α_3	4.29E-03	1.18E-02	1.09E-02	2.22E-02	1.25E-02	4.3650E+00	3.6630E+02
α_4	1.08E-03	5.69E-03	4.83E-03	1.32E-02	6.41E-03	2.1101E+00	3.6856E+02
α_5	1.78E-07	8.71E-04	2.38E-04	3.89E-03	9.24E-04	3.2268E-01	3.7035E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9485080	0.9641060	0.9648030	0.9773320	0.9638820	4.2811E+02	1.5939E+01
α_2	7.52E-03	1.59E-02	1.52E-02	2.67E-02	1.49E-02	7.0503E+00	4.3700E+02
α_3	3.89E-03	1.03E-02	9.62E-03	1.93E-02	1.07E-02	4.5936E+00	4.3946E+02
α_4	1.59E-03	6.25E-03	5.52E-03	1.34E-02	6.76E-03	2.7741E+00	4.4127E+02
α_5	2.74E-04	2.96E-03	2.25E-03	8.04E-03	3.38E-03	1.3124E+00	4.4274E+02
α_6	8.42E-10	4.69E-04	5.42E-05	2.39E-03	3.88E-04	2.0834E-01	4.4384E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9655720	0.9569500	0.9546440	0.9602510	0.9638820
α_2	3.44E-02	3.54E-02	3.05E-02	1.99E-02	1.49E-02
α_3		7.64E-03	1.26E-02	1.25E-02	1.07E-02
α_4			2.30E-03	6.41E-03	6.76E-03
α_5				9.24E-04	3.38E-03
α_6					3.88E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.66E-01	9.57E-01	9.55E-01	9.60E-01	9.64E-01
Beta	3.44E-02	4.30E-02	4.54E-02	3.97E-02	3.61E-02
Gamma		1.78E-01	3.28E-01	4.99E-01	5.87E-01
Delta			1.54E-01	3.70E-01	4.96E-01
Epsilon				1.26E-01	3.58E-01
Mu					1.03E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	100.91	151.37	201.82	252.28	302.73
N_1	8.6940	8.1395	7.1803	7.9240	8.4420
N_2	3.9080	5.9016	6.6751	5.3973	4.8111
N_3		1.2742	2.7520	3.3876	3.4518
N_4			0.5028	1.7357	2.1819
N_5				0.2504	1.0902
N_6					0.1251

1.3.2 Pooled Pump Volutes

1.3.2.1 CLEAN SYSTEM PUMP VOLUTES FAIL TO RUN SPAR: PMP-FR

System :	Chemical and volume control Component cooling water Auxiliary feedwater Containment spray recirculation Low pressure core spray Residual Heat Removal (LCI in BWRs; LPI in PWRs) Standby liquid control
Component :	Motor Driven Pump
Failure Mode :	Fail to Run (Normally running equipment) Fail to Run >1 Hour (Standby equipment) Fail to Run less than 1 Hour
Subcomponent :	Pump
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 109.50
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9617520	0.9836700	0.9861820	0.9970060	0.9859530	1.2255E+02	2.0345E+00
α_2	3.00E-03	1.63E-02	1.38E-02	3.83E-02	1.40E-02	2.0345E+00	1.2255E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9659800	0.9831270	0.9847060	0.9948750	0.9865650	1.9699E+02	3.3809E+00
α_2	2.54E-03	1.17E-02	1.02E-02	2.64E-02	8.96E-03	2.3537E+00	1.9802E+02
α_3	2.82E-04	5.13E-03	3.60E-03	1.52E-02	4.48E-03	1.0272E+00	1.9934E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9679360	0.9826090	0.9837710	0.9933010	0.9871380	2.6855E+02	4.7531E+00
α_2	2.48E-03	9.93E-03	8.76E-03	2.14E-02	6.60E-03	2.7141E+00	2.7059E+02
α_3	5.80E-04	5.27E-03	4.12E-03	1.39E-02	4.60E-03	1.4403E+00	2.7186E+02
α_4	2.05E-05	2.19E-03	1.15E-03	7.88E-03	1.67E-03	5.9867E-01	2.7270E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9859530	0.9865650	0.9871380
α_2	1.40E-02	8.96E-03	6.60E-03
α_3		4.48E-03	4.60E-03
α_4			1.67E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.86E-01	9.87E-01	9.87E-01
Beta	1.40E-02	1.34E-02	1.29E-02
Gamma		3.33E-01	4.87E-01
Delta			2.66E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	109.50	164.25	219.00
N_1	2.8000	3.1800	3.4160
N_2	1.6000	1.5200	1.4860
N_3		0.7600	1.0360
N_4			0.3760

1.3.3 Pooled Clean System Motor Driven Pump Distributions

1.3.3.1 CLEAN SYSTEM MOTOR DRIVEN PUMPS FAIL TO START SPAR: MDP-FS

System : Chemical and volume control
Component cooling water
Auxiliary feedwater
Containment spray recirculation
High pressure core spray
High pressure coolant injection
High pressure injection
Low pressure core spray
Reactor core isolation
Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Standby liquid control

Component : Motor Driven Pump
Failure Mode : Fail to start
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 405.50
Total Number of Common-Cause Failure Events: 15

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9577550	0.9736880	0.9746390	0.9863660	0.9741700	3.2064E+02	8.6645E+00
α_2	1.36E-02	2.63E-02	2.54E-02	4.22E-02	2.58E-02	8.6645E+00	3.2064E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9659210	0.9777020	0.9783340	0.9873330	0.9785840	4.9229E+02	1.1228E+01
α_2	4.79E-03	1.13E-02	1.06E-02	2.00E-02	1.02E-02	5.6787E+00	4.9784E+02
α_3	4.62E-03	1.10E-02	1.04E-02	1.96E-02	1.12E-02	5.5489E+00	4.9797E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9688290	0.9787050	0.9791800	0.9869670	0.9800350	6.5994E+02	1.4359E+01
α_2	4.88E-03	1.04E-02	9.89E-03	1.75E-02	9.20E-03	6.9894E+00	6.6731E+02
α_3	2.49E-03	6.70E-03	6.22E-03	1.26E-02	6.57E-03	4.5167E+00	6.6978E+02
α_4	1.10E-03	4.23E-03	3.75E-03	8.99E-03	4.20E-03	2.8530E+00	6.7145E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9726380	0.9808160	0.9811770	0.9877530	0.9829010	8.6239E+02	1.6868E+01
α_2	3.50E-03	7.60E-03	7.23E-03	1.30E-02	5.86E-03	6.6839E+00	8.7257E+02
α_3	2.31E-03	5.79E-03	5.42E-03	1.05E-02	5.27E-03	5.0884E+00	8.7417E+02
α_4	1.37E-03	4.22E-03	3.85E-03	8.33E-03	4.28E-03	3.7099E+00	8.7555E+02
α_5	1.62E-04	1.58E-03	1.22E-03	4.21E-03	1.68E-03	1.3857E+00	8.7787E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9754470	0.9825540	0.9828550	0.9886230	0.9848740	1.0355E+03	1.8386E+01
α_2	2.59E-03	5.84E-03	5.54E-03	1.02E-02	4.20E-03	6.1598E+00	1.0477E+03
α_3	1.80E-03	4.62E-03	4.31E-03	8.50E-03	4.00E-03	4.8699E+00	1.0490E+03
α_4	1.34E-03	3.87E-03	3.56E-03	7.45E-03	3.74E-03	4.0769E+00	1.0498E+03
α_5	5.62E-04	2.41E-03	2.10E-03	5.30E-03	2.48E-03	2.5395E+00	1.0513E+03
α_6	1.48E-05	7.02E-04	4.22E-04	2.34E-03	7.04E-04	7.3964E-01	1.0531E+03

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9741700	0.9785840	0.9800350	0.9829010	0.9848740
α_2	2.58E-02	1.02E-02	9.20E-03	5.86E-03	4.20E-03
α_3		1.12E-02	6.57E-03	5.27E-03	4.00E-03
α_4			4.20E-03	4.28E-03	3.74E-03
α_5				1.68E-03	2.48E-03
α_6					7.04E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.74E-01	9.79E-01	9.80E-01	9.83E-01	9.85E-01
Beta	2.58E-02	2.14E-02	2.00E-02	1.71E-02	1.51E-02
Gamma		5.22E-01	5.39E-01	6.57E-01	7.22E-01
Delta			3.90E-01	5.31E-01	6.34E-01
Epsilon				2.83E-01	4.60E-01
Mu					2.21E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	303.75	455.62	607.49	759.36	911.24
N_1	6.6400	7.1150	6.3171	6.8643	7.3041
N_2	8.2300	4.8450	5.7613	4.5697	3.9206
N_3		5.2817	4.1124	4.1110	3.7281
N_4			2.6303	3.3355	3.4847
N_5				1.3134	2.3173
N_6					0.6564

1.3.3.2 CLEAN SYSTEM MDP-FTR LESS THAN 1 HOUR

System :	Chemical and volume control Component cooling water Auxiliary feedwater Containment spray recirculation High pressure core spray High pressure coolant injection High pressure injection Low pressure core spray Reactor core isolation Residual Heat Removal (LCI in BWRs; LPI in PWRs) Standby liquid control
Component :	Motor Driven Pump
Failure Mode :	Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 26.10
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8777800	0.9499120	0.9585060	0.9925840	0.9455960	3.2263E+01	1.7012E+00
α_2	7.41E-03	5.01E-02	4.15E-02	1.22E-01	5.44E-02	1.7012E+00	3.2263E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9071070	0.9554700	0.9600960	0.9880020	0.9477090	6.1815E+01	2.8809E+00
α_2	6.28E-03	3.25E-02	2.78E-02	7.48E-02	3.73E-02	2.1037E+00	6.2592E+01
α_3	3.04E-04	1.20E-02	7.49E-03	3.91E-02	1.50E-02	7.7722E-01	6.3919E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9118520	0.9526850	0.9559200	0.9824620	0.9433530	8.8152E+01	4.3781E+00
α_2	8.79E-03	3.20E-02	2.87E-02	6.66E-02	3.90E-02	2.9641E+00	8.9566E+01
α_3	4.49E-04	1.02E-02	6.92E-03	3.10E-02	1.20E-02	9.4031E-01	9.1590E+01
α_4	1.51E-05	5.12E-03	2.23E-03	2.00E-02	5.64E-03	4.7367E-01	9.2056E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9298180	0.9589270	0.9608910	0.9813210	0.9488020	1.4832E+02	6.3529E+00
α_2	7.57E-03	2.35E-02	2.15E-02	4.63E-02	2.77E-02	3.6349E+00	1.5104E+02
α_3	1.73E-03	1.14E-02	9.39E-03	2.80E-02	1.44E-02	1.7667E+00	1.5291E+02
α_4	1.11E-04	4.87E-03	2.97E-03	1.61E-02	6.90E-03	7.5389E-01	1.5392E+02
α_5	1.08E-09	1.28E-03	1.28E-04	6.60E-03	2.28E-03	1.9738E-01	1.5448E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9342740	0.9602190	0.9618530	0.9805770	0.9519010	1.7913E+02	7.4212E+00
α_2	6.56E-03	2.00E-02	1.83E-02	3.92E-02	2.28E-02	3.7303E+00	1.8282E+02
α_3	1.88E-03	1.06E-02	8.93E-03	2.52E-02	1.29E-02	1.9820E+00	1.8457E+02
α_4	3.71E-04	5.85E-03	4.20E-03	1.69E-02	7.63E-03	1.0905E+00	1.8546E+02
α_5	7.37E-06	2.53E-03	1.10E-03	9.92E-03	3.83E-03	4.7270E-01	1.8608E+02
α_6	3.99E-12	7.81E-04	2.92E-05	4.33E-03	9.57E-04	1.4574E-01	1.8641E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9455960	0.9477090	0.9433530	0.9488020	0.9519010
α_2	5.44E-02	3.73E-02	3.90E-02	2.77E-02	2.28E-02
α_3		1.50E-02	1.20E-02	1.44E-02	1.29E-02
α_4			5.64E-03	6.90E-03	7.63E-03
α_5				2.28E-03	3.83E-03
α_6					9.57E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.46E-01	9.48E-01	9.43E-01	9.49E-01	9.52E-01
Beta	5.44E-02	5.23E-02	5.66E-02	5.12E-02	4.81E-02
Gamma		2.87E-01	3.12E-01	4.60E-01	5.26E-01
Delta			3.19E-01	3.90E-01	4.91E-01
Epsilon				2.48E-01	3.86E-01
Mu					2.00E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	19.55	29.33	39.10	48.88	58.65
N_1	2.4667	2.9300	2.9160	3.2805	3.5429
N_2	1.2667	1.2700	1.7360	1.5207	1.4911
N_3		0.5100	0.5360	0.7893	0.8402
N_4			0.2510	0.3795	0.4983
N_5				0.1251	0.2505
N_6					0.0625

1.3.3.3 CLEAN SYSTEM MDP-FTR LESS THAN AND > 1 HOUR SPAR: MDP-FR

System :	Chemical and volume control Component cooling water Auxiliary feedwater Containment spray recirculation High pressure core spray High pressure coolant injection High pressure injection Low pressure core spray Reactor core isolation Residual Heat Removal (LCI in BWRs; LPI in PWRs) Standby liquid control
Component :	Motor Driven Pump
Failure Mode :	Fail to Run (Normally running equipment) Fail to Run >1 Hour (Standby equipment) Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 272.00
Total Number of Common-Cause Failure Events: 11

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9569330	0.9761620	0.9776290	0.9903900	0.9770440	2.0959E+02	5.1182E+00
α_2	9.61E-03	2.38E-02	2.24E-02	4.31E-02	2.30E-02	5.1182E+00	2.0959E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9583350	0.9740720	0.9750180	0.9865850	0.9750850	3.2429E+02	8.6319E+00
α_2	8.11E-03	1.83E-02	1.74E-02	3.18E-02	1.74E-02	6.1047E+00	3.2682E+02
α_3	1.77E-03	7.59E-03	6.63E-03	1.67E-02	7.48E-03	2.5272E+00	3.3039E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9625680	0.9756210	0.9763280	0.9862690	0.9773340	4.3708E+02	1.0922E+01
α_2	5.81E-03	1.33E-02	1.26E-02	2.33E-02	1.18E-02	5.9661E+00	4.4204E+02
α_3	2.56E-03	8.05E-03	7.33E-03	1.60E-02	8.01E-03	3.6070E+00	4.4439E+02
α_4	2.94E-04	3.01E-03	2.31E-03	8.12E-03	2.81E-03	1.3487E+00	4.4665E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9666520	0.9774580	0.9779910	0.9864560	0.9800520	5.8376E+02	1.3463E+01
α_2	4.34E-03	9.97E-03	9.43E-03	1.74E-02	7.72E-03	5.9530E+00	5.9127E+02
α_3	2.67E-03	7.33E-03	6.79E-03	1.38E-02	6.83E-03	4.3779E+00	5.9284E+02
α_4	9.59E-04	4.18E-03	3.64E-03	9.24E-03	4.27E-03	2.4970E+00	5.9473E+02
α_5	1.27E-05	1.06E-03	5.82E-04	3.75E-03	1.13E-03	6.3488E-01	5.9659E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9695850	0.9790730	0.9795160	0.9870440	0.9820010	7.0112E+02	1.4986E+01
α_2	3.31E-03	7.85E-03	7.40E-03	1.39E-02	5.68E-03	5.6206E+00	7.1049E+02
α_3	2.11E-03	5.93E-03	5.47E-03	1.13E-02	5.22E-03	4.2444E+00	7.1186E+02
α_4	1.29E-03	4.47E-03	4.02E-03	9.20E-03	4.39E-03	3.2027E+00	7.1290E+02
α_5	2.70E-04	2.17E-03	1.73E-03	5.58E-03	2.24E-03	1.5538E+00	7.1455E+02
α_6	2.74E-07	5.09E-04	1.65E-04	2.18E-03	4.73E-04	3.6454E-01	7.1574E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9770440	0.9750850	0.9773340	0.9800520	0.9820010
α_2	2.30E-02	1.74E-02	1.18E-02	7.72E-03	5.68E-03
α_3		7.48E-03	8.01E-03	6.83E-03	5.22E-03
α_4			2.81E-03	4.27E-03	4.39E-03
α_5				1.13E-03	2.24E-03
α_6					4.73E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.77E-01	9.75E-01	9.77E-01	9.80E-01	9.82E-01
Beta	2.30E-02	2.49E-02	2.27E-02	1.99E-02	1.80E-02
Gamma		3.00E-01	4.77E-01	6.13E-01	6.84E-01
Delta			2.60E-01	4.41E-01	5.76E-01
Epsilon				2.10E-01	3.82E-01
Mu					1.74E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	192.91	289.36	385.82	482.27	578.72
N_1	6.4327	5.3780	5.1231	5.3317	5.4585
N_2	4.6837	5.2710	4.7380	3.8388	3.3814
N_3		2.2600	3.2027	3.4005	3.1026
N_4			1.1260	2.1226	2.6105
N_5				0.5626	1.3316
N_6					0.2813

1.3.3.4 CLEAN SYSTEM MDP-FTR > 1 HOUR

System : Chemical and volume control
Component cooling water
Auxiliary feedwater
Containment spray recirculation
High pressure core spray
High pressure coolant injection
High pressure injection
Low pressure core spray
Reactor core isolation
Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Standby liquid control

Component : Motor Driven Pump
Failure Mode : Fail to Run >1 Hour (Standby equipment)
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 48.90
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9074090	0.9606800	0.9667600	0.9931230	0.9610580	4.7272E+01	1.9348E+00
α_2	6.88E-03	3.93E-02	3.32E-02	9.26E-02	3.89E-02	1.9348E+00	4.7272E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9188810	0.9586960	0.9621580	0.9866580	0.9557730	8.3603E+01	3.6019E+00
α_2	8.57E-03	3.25E-02	2.90E-02	6.85E-02	3.54E-02	2.8347E+00	8.4370E+01
α_3	2.12E-04	8.80E-03	5.43E-03	2.88E-02	8.84E-03	7.6722E-01	8.6438E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9315150	0.9630690	0.9655680	0.9860890	0.9641810	1.1797E+02	4.5238E+00
α_2	4.66E-03	2.02E-02	1.77E-02	4.46E-02	1.68E-02	2.4801E+00	1.2001E+02
α_3	1.64E-03	1.28E-02	1.03E-02	3.27E-02	1.57E-02	1.5710E+00	1.2092E+02
α_4	1.12E-05	3.86E-03	1.68E-03	1.51E-02	3.36E-03	4.7267E-01	1.2202E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9433410	0.9669150	0.9685270	0.9849940	0.9695080	1.8577E+02	6.3565E+00
α_2	4.22E-03	1.55E-02	1.38E-02	3.24E-02	9.30E-03	2.9740E+00	1.8915E+02
α_3	2.14E-03	1.11E-02	9.44E-03	2.57E-02	1.25E-02	2.1302E+00	1.9000E+02
α_4	3.22E-04	5.49E-03	3.90E-03	1.61E-02	7.36E-03	1.0550E+00	1.9107E+02
α_5	8.64E-10	1.03E-03	1.03E-04	5.31E-03	1.35E-03	1.9728E-01	1.9193E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9480430	0.9688100	0.9701490	0.9849940	0.9733210	2.2432E+02	7.2218E+00
α_2	3.28E-03	1.24E-02	1.10E-02	2.63E-02	5.77E-03	2.8761E+00	2.2867E+02
α_3	1.74E-03	9.12E-03	7.75E-03	2.12E-02	8.80E-03	2.1125E+00	2.2943E+02
α_4	7.26E-04	6.36E-03	5.00E-03	1.66E-02	7.97E-03	1.4718E+00	2.3007E+02
α_5	2.80E-05	2.66E-03	1.43E-03	9.47E-03	3.57E-03	6.1570E-01	2.3093E+02
α_6	3.22E-12	6.29E-04	2.35E-05	3.49E-03	5.67E-04	1.4574E-01	2.3140E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9610580	0.9557730	0.9641810	0.9695080	0.9733210
α_2	3.89E-02	3.54E-02	1.68E-02	9.30E-03	5.77E-03
α_3		8.84E-03	1.57E-02	1.25E-02	8.80E-03
α_4			3.36E-03	7.36E-03	7.97E-03
α_5				1.35E-03	3.57E-03
α_6					5.67E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.61E-01	9.56E-01	9.64E-01	9.70E-01	9.73E-01
Beta	3.89E-02	4.42E-02	3.58E-02	3.05E-02	2.67E-02
Gamma		2.00E-01	5.31E-01	6.95E-01	7.84E-01
Delta			1.76E-01	4.11E-01	5.79E-01
Epsilon				1.55E-01	3.41E-01
Mu					1.37E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	35.56	53.35	71.13	88.91	106.69
N_1	1.4660	0.6980	0.7071	0.6971	0.6864
N_2	1.5003	2.0010	1.2520	0.8598	0.6369
N_3		0.5000	1.1667	1.1528	0.9707
N_4			0.2500	0.6806	0.8796
N_5				0.1250	0.3935
N_6					0.0625

1.3.4 PWR Containment Spray Pumps

1.3.4.1 CONTAINMENT SPRAY MDP-FS

System : Containment spray recirculation
Component : Motor Driven Pump
Failure Mode : Fail to start
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 30.00
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8793800	0.9443320	0.9508660	0.9868970	0.9396170	4.2146E+01	2.4845E+00
α_2	1.31E-02	5.57E-02	4.91E-02	1.21E-01	6.04E-02	2.4845E+00	4.2146E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	0.9396170
α_2	6.04E-02

MGL Parameter	CCCG=2
1-Beta	9.40E-01
Beta	6.04E-02

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	30.00
N_1	1.9000
N_2	2.0500

1.3.4.2 CONTAINMENT SPRAY FTR LESS THAN 1H MDP-FH

System :	Containment spray recirculation
Component :	Motor Driven Pump
Failure Mode :	Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 7.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9017830	0.9754240	0.9898730	0.9999510	1.0000000	1.7246E+01	4.3452E-01
α_2	4.52E-05	2.46E-02	1.01E-02	9.82E-02	0.00E+00	4.3452E-01	1.7246E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	1.0000000
α_2	0.00E+00

MGL Parameter	CCCG=2
1-Beta	1.00E+00
Beta	0.00E+00

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	7.00
N_1	0.0000
N_2	0.0000

1.3.4.3 CONTAINMENT SPRAY MDP-FTR LESS THAN AND > 1 HOUR

System :	Containment spray recirculation
Component :	Motor Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment) Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 13.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9267760	0.9817280	0.9925460	0.9999640	1.0000000	2.3346E+01	4.3452E-01
α_2	3.33E-05	1.83E-02	7.46E-03	7.32E-02	0.00E+00	4.3452E-01	2.3346E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	1.0000000
α_2	0.00E+00

MGL Parameter	CCCG=2
1-Beta	1.00E+00
Beta	0.00E+00

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	13.10
N_1	0.0000
N_2	0.0000

1.3.4.4 CONTAINMENT SPRAY >1H MDP-FR

System :	Containment spray recirculation
Component :	Motor Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment)
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 6.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8965820	0.9741060	0.9893090	0.9999480	1.0000000	1.6346E+01	4.3452E-01
α_2	4.78E-05	2.59E-02	1.07E-02	1.03E-01	0.00E+00	4.3452E-01	1.6346E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	1.0000000
α_2	0.00E+00

MGL Parameter	CCCG=2
1-Beta	1.00E+00
Beta	0.00E+00

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	6.10
N_1	0.0000
N_2	0.0000

1.3.5 BWR Residual Heat Removal Pumps

1.3.5.1 BWR RHR MDP FAIL TO START

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Motor Driven Pump
Failure Mode :	Fail to start
Op. Mode :	CCF Event Can Only Happen During Power Operation CCF Event May Occur During Both Power Operation & Shutdown
Plant Type :	BWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 32.00
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9120680	0.9729130	0.9830010	0.9993270	0.9811340	2.7579E+01	7.6782E-01
α_2	6.70E-04	2.71E-02	1.70E-02	8.79E-02	1.89E-02	7.6782E-01	2.7579E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9148010	0.9629180	0.9682380	0.9928270	0.9615380	5.4555E+01	2.1009E+00
α_2	5.25E-03	3.24E-02	2.70E-02	7.78E-02	3.85E-02	1.8337E+00	5.4822E+01
α_3	1.65E-07	4.72E-03	9.49E-04	2.24E-02	0.00E+00	2.6722E-01	5.6389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9094870	0.9529820	0.9566300	0.9840010	0.9411760	7.8136E+01	3.8551E+00
α_2	1.17E-02	3.94E-02	3.57E-02	7.97E-02	5.88E-02	3.2281E+00	7.8763E+01
α_3	5.54E-06	4.93E-03	1.82E-03	2.04E-02	0.00E+00	4.0431E-01	8.1587E+01
α_4	1.17E-08	2.72E-03	3.71E-04	1.36E-02	0.00E+00	2.2267E-01	8.1768E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9811340	0.9615380	0.9411760
α_2	1.89E-02	3.85E-02	5.88E-02
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.81E-01	9.62E-01	9.41E-01
Beta	1.89E-02	3.85E-02	5.88E-02
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	16.00	24.00	32.00
N_1	1.3333	1.0000	0.0000
N_2	0.3333	1.0000	2.0000
N_3		0.0000	0.0000
N_4			0.0000

1.3.5.2 BWR RHR MDP FTR LESS THAN 1H

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Motor Driven Pump
Failure Mode :	Fail to Run less than 1 Hour
Op. Mode :	
Plant Type :	BWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 5.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8894200	0.9722890	0.9885280	0.9999450	1.0000000	1.5246E+01	4.3452E-01
α_2	5.13E-05	2.77E-02	1.15E-02	1.11E-01	0.00E+00	4.3452E-01	1.5246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9119790	0.9691250	0.9774000	0.9979500	1.0000000	3.4555E+01	1.1009E+00
α_2	7.46E-04	2.34E-02	1.52E-02	7.38E-02	0.00E+00	8.3366E-01	3.4822E+01
α_3	2.64E-07	7.49E-03	1.52E-03	3.55E-02	0.00E+00	2.6722E-01	3.5389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9162960	0.9649930	0.9706750	0.9942240	1.0000000	5.1136E+01	1.8551E+00
α_2	1.92E-03	2.32E-02	1.75E-02	6.39E-02	0.00E+00	1.2281E+00	5.1763E+01
α_3	8.61E-06	7.63E-03	2.84E-03	3.15E-02	0.00E+00	4.0431E-01	5.2587E+01
α_4	1.82E-08	4.20E-03	5.77E-04	2.11E-02	0.00E+00	2.2267E-01	5.2768E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	5.00	5.00	5.00
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.3.5.3 BWR RHR MDP FAIL TO RUN

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Motor Driven Pump
Failure Mode :	Fail to Run (Normally running equipment) Fail to Run >1 Hour (Standby equipment) Fail to Run less than 1 Hour
Op. Mode :	CCF Event Can Only Happen During Power Operation CCF Event May Occur During Both Power Operation & Shutdown
Plant Type :	BWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 12.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9248960	0.9812550	0.9923480	0.9999630	1.0000000	2.2746E+01	4.3452E-01
α_2	3.42E-05	1.87E-02	7.66E-03	7.51E-02	0.00E+00	4.3452E-01	2.2746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9270750	0.9744910	0.9813880	0.9983130	1.0000000	4.2055E+01	1.1009E+00
α_2	6.14E-04	1.93E-02	1.25E-02	6.11E-02	0.00E+00	8.3366E-01	4.2322E+01
α_3	2.17E-07	6.19E-03	1.25E-03	2.94E-02	0.00E+00	2.6722E-01	4.2889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9265240	0.9693330	0.9743550	0.9949510	1.0000000	5.8636E+01	1.8551E+00
α_2	1.68E-03	2.03E-02	1.53E-02	5.60E-02	0.00E+00	1.2281E+00	5.9263E+01
α_3	7.53E-06	6.68E-03	2.48E-03	2.76E-02	0.00E+00	4.0431E-01	6.0087E+01
α_4	1.59E-08	3.68E-03	5.04E-04	1.84E-02	0.00E+00	2.2267E-01	6.0268E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	12.50	12.50	12.50
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.3.5.4 BWR RHR MDP FAIL TO RUN >1H

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Motor Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment)
Op. Mode :	CCF Event Can Only Happen During Power Operation CCF Event May Occur During Both Power Operation & Shutdown
Plant Type :	BWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 7.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9044540	0.9761000	0.9901620	0.9999520	1.0000000	1.7746E+01	4.3452E-01
α_2	4.39E-05	2.39E-02	9.84E-03	9.55E-02	0.00E+00	4.3452E-01	1.7746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9176630	0.9711480	0.9789060	0.9980930	1.0000000	3.7055E+01	1.1009E+00
α_2	6.96E-04	2.18E-02	1.42E-02	6.91E-02	0.00E+00	8.3366E-01	3.7322E+01
α_3	2.46E-07	7.00E-03	1.42E-03	3.32E-02	0.00E+00	2.6722E-01	3.7889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9200060	0.9665700	0.9720120	0.9944910	1.0000000	5.3636E+01	1.8551E+00
α_2	1.84E-03	2.21E-02	1.67E-02	6.10E-02	0.00E+00	1.2281E+00	5.4263E+01
α_3	8.22E-06	7.29E-03	2.71E-03	3.01E-02	0.00E+00	4.0431E-01	5.5087E+01
α_4	1.73E-08	4.01E-03	5.50E-04	2.01E-02	0.00E+00	2.2267E-01	5.5268E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	7.50	7.50	7.50
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.3.6 AFW Motor-Driven Pumps

1.3.6.1 AFW MOTOR DRIVEN PUMP FAIL TO START SPAR: AFW-MDP-FS

System :	Auxiliary feedwater
Component :	Motor Driven Pump
Failure Mode :	Fail to start
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 35.20
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8901910	0.9532060	0.9603450	0.9917690	0.9510760	3.9406E+01	1.9345E+00
α_2	8.23E-03	4.68E-02	3.97E-02	1.10E-01	4.89E-02	1.9345E+00	3.9406E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9161240	0.9590080	0.9629980	0.9882470	0.9555460	7.2545E+01	3.1009E+00
α_2	2.72E-03	2.09E-02	1.69E-02	5.30E-02	1.67E-02	1.5837E+00	7.4062E+01
α_3	2.43E-03	2.01E-02	1.60E-02	5.16E-02	2.78E-02	1.5172E+00	7.4129E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9256310	0.9605370	0.9633700	0.9857450	0.9598780	1.0296E+02	4.2301E+00
α_2	3.27E-03	1.85E-02	1.56E-02	4.36E-02	1.27E-02	1.9781E+00	1.0521E+02
α_3	1.39E-03	1.31E-02	1.02E-02	3.47E-02	1.69E-02	1.4043E+00	1.0579E+02
α_4	2.61E-04	7.91E-03	5.13E-03	2.50E-02	1.06E-02	8.4767E-01	1.0634E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9510760	0.9555460	0.9598780
α_2	4.89E-02	1.67E-02	1.27E-02
α_3		2.78E-02	1.69E-02
α_4			1.06E-02

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.51E-01	9.56E-01	9.60E-01
Beta	4.89E-02	4.45E-02	4.01E-02
Gamma		6.25E-01	6.84E-01
Delta			3.85E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	28.16	42.24	56.32
N_1	1.0000	0.7500	0.5000
N_2	1.5000	0.7500	0.7500
N_3		1.2500	1.0000
N_4			0.6250

1.3.6.2 AFW MOTOR DRIVEN PUMP FTR LESS THAN 1H SPAR: AFW-MDP-FH

System :	Auxiliary feedwater
Component :	Motor Driven Pump
Failure Mode :	Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 6.50
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8683400	0.9604820	0.9761100	0.9992710	0.9622420	1.7043E+01	7.0122E-01
α_2	7.26E-04	3.95E-02	2.39E-02	1.32E-01	3.78E-02	7.0122E-01	1.7043E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8909990	0.9539730	0.9612000	0.9922030	0.9236040	3.8985E+01	1.8809E+00
α_2	5.28E-03	3.92E-02	3.20E-02	9.81E-02	7.54E-02	1.6037E+00	3.9262E+01
α_3	3.46E-07	6.78E-03	1.47E-03	3.18E-02	9.79E-04	2.7722E-01	4.0589E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8901110	0.9447120	0.9495170	0.9828820	0.8838200	5.7722E+01	3.3781E+00
α_2	1.13E-02	4.44E-02	3.95E-02	9.43E-02	1.13E-01	2.7141E+00	5.8386E+01
α_3	1.40E-05	7.21E-03	2.93E-03	2.89E-02	2.75E-03	4.4031E-01	6.0660E+01
α_4	1.67E-08	3.66E-03	5.07E-04	1.83E-02	7.63E-05	2.2367E-01	6.0876E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9622420	0.9236040	0.8838200
α_2	3.78E-02	7.54E-02	1.13E-01
α_3		9.79E-04	2.75E-03
α_4			7.63E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.62E-01	9.24E-01	8.84E-01
Beta	3.78E-02	7.64E-02	1.16E-01
Gamma		1.28E-02	2.43E-02
Delta			2.70E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	4.33	6.50	8.67
N_1	2.4667	2.9300	2.9160
N_2	0.2667	0.7700	1.4860
N_3		0.0100	0.0360
N_4			0.0010

1.3.6.3 AFW MOTOR DRIVEN PUMP FAIL TO RUN SPAR: AFW-MDP-FR

System :	Auxiliary feedwater
Component :	Motor Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment) Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 13.20
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8943690	0.9684340	0.9810610	0.9994230	0.9768760	2.1513E+01	7.0122E-01
α_2	5.74E-04	3.16E-02	1.89E-02	1.06E-01	2.31E-02	7.0122E-01	2.1513E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9060670	0.9604570	0.9667380	0.9933320	0.9538730	4.5685E+01	1.8809E+00
α_2	4.51E-03	3.37E-02	2.74E-02	8.45E-02	4.55E-02	1.6037E+00	4.5962E+01
α_3	2.97E-07	5.83E-03	1.26E-03	2.73E-02	5.91E-04	2.7722E-01	4.7289E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9038660	0.9517620	0.9560100	0.9851140	0.9308950	6.6652E+01	3.3781E+00
α_2	9.85E-03	3.88E-02	3.44E-02	8.24E-02	6.74E-02	2.7141E+00	6.7316E+01
α_3	1.22E-05	6.29E-03	2.56E-03	2.52E-02	1.63E-03	4.4031E-01	6.9590E+01
α_4	1.46E-08	3.19E-03	4.42E-04	1.60E-02	4.54E-05	2.2367E-01	6.9806E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9768760	0.9538730	0.9308950
α_2	2.31E-02	4.55E-02	6.74E-02
α_3		5.91E-04	1.63E-03
α_4			4.54E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.77E-01	9.54E-01	9.31E-01
Beta	2.31E-02	4.61E-02	6.91E-02
Gamma		1.28E-02	2.43E-02
Delta			2.70E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	8.80	13.20	17.60
N_1	2.4667	2.9300	2.9160
N_2	0.2667	0.7700	1.4860
N_3		0.0100	0.0360
N_4			0.0010

1.3.6.4 AFW MOTOR DRIVEN PUMP FAIL TO RUN >1H

System :	Auxiliary feedwater
Component :	Motor Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment)
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 6.70
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9001110	0.9750000	0.9896920	0.9999500	1.0000000	1.6946E+01	4.3452E-01
α_2	4.60E-05	2.50E-02	1.03E-02	9.99E-02	0.00E+00	4.3452E-01	1.6946E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9159270	0.9705300	0.9784470	0.9980510	1.0000000	3.6255E+01	1.1009E+00
α_2	7.11E-04	2.23E-02	1.45E-02	7.05E-02	0.00E+00	8.3366E-01	3.6522E+01
α_3	2.51E-07	7.15E-03	1.45E-03	3.39E-02	0.00E+00	2.6722E-01	3.7089E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9188550	0.9660810	0.9715970	0.9944080	1.0000000	5.2836E+01	1.8551E+00
α_2	1.86E-03	2.25E-02	1.69E-02	6.19E-02	0.00E+00	1.2281E+00	5.3463E+01
α_3	8.34E-06	7.39E-03	2.75E-03	3.05E-02	0.00E+00	4.0431E-01	5.4287E+01
α_4	1.76E-08	4.07E-03	5.58E-04	2.04E-02	0.00E+00	2.2267E-01	5.4468E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	6.70	6.70	6.70
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.3.7 AFW Pump Volutes

1.3.7.1 AFW PUMP VOLUTES (MDP,TDP,EDP) FAIL TO RUN SPAR: AFW-PMP-FR

System : Auxiliary feedwater
Component :
Failure Mode : Fail to Run >1 Hour (Standby equipment)
Fail to Run less than 1 Hour
Subcomponent : Pump
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 17.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9372450	0.9843590	0.9936440	0.9999690	1.0000000	2.7346E+01	4.3452E-01
α_2	2.84E-05	1.56E-02	6.36E-03	6.28E-02	0.00E+00	4.3452E-01	2.7346E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9340150	0.9769480	0.9832060	0.9984850	1.0000000	4.6655E+01	1.1009E+00
α_2	5.53E-04	1.75E-02	1.13E-02	5.53E-02	0.00E+00	8.3366E-01	4.6922E+01
α_3	1.96E-07	5.60E-03	1.13E-03	2.65E-02	0.00E+00	2.6722E-01	4.7489E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9316520	0.9715000	0.9761860	0.9953150	1.0000000	6.3236E+01	1.8551E+00
α_2	1.56E-03	1.89E-02	1.42E-02	5.21E-02	0.00E+00	1.2281E+00	6.3863E+01
α_3	6.99E-06	6.21E-03	2.30E-03	2.57E-02	0.00E+00	4.0431E-01	6.4687E+01
α_4	1.48E-08	3.42E-03	4.68E-04	1.71E-02	0.00E+00	2.2267E-01	6.4868E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	17.10	17.10	17.10
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.3.8 Emergency Service Water Pump

1.3.8.1 NORMALLY RUNNING SERVICE WATER MDP FAIL TO START

System : Normally operating service water
Component : Motor Driven Pump
Failure Mode : Fail to start
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 26.50
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9397830	0.9847910	0.9935850	0.9999630	0.9991200	2.9216E+01	4.5122E-01
α_2	3.46E-05	1.52E-02	6.42E-03	6.02E-02	8.80E-04	4.5122E-01	2.9216E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9450120	0.9805280	0.9856320	0.9985890	0.9982430	5.7955E+01	1.1509E+00
α_2	5.60E-04	1.50E-02	9.94E-03	4.64E-02	1.76E-03	8.8366E-01	5.8222E+01
α_3	1.58E-07	4.52E-03	9.09E-04	2.14E-02	0.00E+00	2.6722E-01	5.8839E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9462090	0.9772650	0.9808620	0.9960240	0.9974250	8.3936E+01	1.9527E+00
α_2	1.47E-03	1.54E-02	1.18E-02	4.16E-02	2.54E-03	1.3244E+00	8.4564E+01
α_3	5.42E-06	4.72E-03	1.75E-03	1.95E-02	3.43E-05	4.0561E-01	8.5483E+01
α_4	1.12E-08	2.59E-03	3.54E-04	1.30E-02	0.00E+00	2.2267E-01	8.5666E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9506680	0.9748540	0.9769800	0.9917880	0.9966370	1.4334E+02	3.6974E+00
α_2	3.22E-03	1.54E-02	1.33E-02	3.50E-02	3.29E-03	2.2698E+00	1.4477E+02
α_3	3.28E-04	6.67E-03	4.61E-03	2.01E-02	7.60E-05	9.8098E-01	1.4606E+02
α_4	1.67E-06	2.55E-03	8.56E-04	1.08E-02	0.00E+00	3.7439E-01	1.4666E+02
α_5	4.05E-21	4.92E-04	2.78E-07	2.84E-03	0.00E+00	7.2277E-02	1.4697E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9527620	0.9746410	0.9764020	0.9905090	0.9958680	1.7346E+02	4.5132E+00
α_2	3.16E-03	1.39E-02	1.21E-02	3.06E-02	4.00E-03	2.4662E+00	1.7551E+02
α_3	4.60E-04	6.46E-03	4.73E-03	1.84E-02	1.30E-04	1.1492E+00	1.7682E+02
α_4	2.97E-05	3.33E-03	1.74E-03	1.20E-02	1.76E-06	5.9232E-01	1.7738E+02
α_5	5.21E-09	1.25E-03	1.69E-04	6.25E-03	0.00E+00	2.2220E-01	1.7775E+02
α_6	7.91E-19	4.68E-04	8.17E-07	2.73E-03	0.00E+00	8.3237E-02	1.7789E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9991200	0.9982430	0.9974250	0.9966370	0.9958680
α_2	8.80E-04	1.76E-03	2.54E-03	3.29E-03	4.00E-03
α_3		0.00E+00	3.43E-05	7.60E-05	1.30E-04
α_4			0.00E+00	0.00E+00	1.76E-06
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.99E-01	9.98E-01	9.97E-01	9.97E-01	9.96E-01
Beta	8.80E-04	1.76E-03	2.58E-03	3.36E-03	4.13E-03
Gamma		0.00E+00	1.33E-02	2.26E-02	3.20E-02
Delta			0.00E+00	0.00E+00	1.33E-02
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	17.67	26.50	35.33	44.17	53.00
N_1	1.3000	1.9000	2.4700	3.0103	3.5221
N_2	0.0167	0.0500	0.0963	0.1556	0.2270
N_3		0.0000	0.0013	0.0036	0.0074
N_4			0.0000	0.0000	0.0001
N_5				0.0000	0.0000
N_6					0.0000

1.3.8.2 NORMALLY RUNNING SERVICE WATER MDP FAIL TO RUN

System :	Normally operating service water
Component :	Motor Driven Pump
Failure Mode :	Fail to Run (Normally running equipment)
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 59.80
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9202590	0.9671920	0.9727930	0.9949350	0.9691390	5.2116E+01	1.7678E+00
α_2	5.06E-03	3.28E-02	2.72E-02	7.97E-02	3.09E-02	1.7678E+00	5.2116E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9326080	0.9671710	0.9704150	0.9906290	0.9686520	9.1355E+01	3.1009E+00
α_2	3.12E-03	1.94E-02	1.61E-02	4.69E-02	1.57E-02	1.8337E+00	9.2622E+01
α_3	1.18E-03	1.34E-02	1.02E-02	3.68E-02	1.57E-02	1.2672E+00	9.3189E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9382490	0.9670630	0.9693920	0.9879100	0.9703190	1.2787E+02	4.3551E+00
α_2	4.30E-03	1.87E-02	1.64E-02	4.13E-02	1.48E-02	2.4781E+00	1.2975E+02
α_3	6.29E-04	8.73E-03	6.41E-03	2.48E-02	8.90E-03	1.1543E+00	1.3107E+02
α_4	1.07E-04	5.47E-03	3.26E-03	1.83E-02	5.94E-03	7.2267E-01	1.3150E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9455120	0.9679890	0.9695040	0.9852880	0.9713040	1.9771E+02	6.5383E+00
α_2	5.49E-03	1.74E-02	1.58E-02	3.46E-02	1.38E-02	3.5517E+00	2.0070E+02
α_3	1.24E-03	8.46E-03	6.92E-03	2.09E-02	7.17E-03	1.7274E+00	2.0252E+02
α_4	2.00E-04	4.59E-03	3.11E-03	1.40E-02	5.38E-03	9.3689E-01	2.0331E+02
α_5	3.19E-07	1.58E-03	4.32E-04	7.05E-03	2.39E-03	3.2228E-01	2.0393E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9483120	0.9685030	0.9697640	0.9843830	0.9721950	2.3823E+02	7.7474E+00
α_2	5.09E-03	1.54E-02	1.41E-02	3.01E-02	1.24E-02	3.7861E+00	2.4219E+02
α_3	1.45E-03	8.14E-03	6.85E-03	1.92E-02	6.89E-03	2.0012E+00	2.4398E+02
α_4	3.23E-04	4.63E-03	3.38E-03	1.32E-02	4.38E-03	1.1391E+00	2.4484E+02
α_5	2.57E-05	2.49E-03	1.33E-03	8.89E-03	3.13E-03	6.1280E-01	2.4536E+02
α_6	1.51E-09	8.47E-04	9.78E-05	4.32E-03	1.00E-03	2.0824E-01	2.4577E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9691390	0.9686520	0.9703190	0.9713040	0.9721950
α_2	3.09E-02	1.57E-02	1.48E-02	1.38E-02	1.24E-02
α_3		1.57E-02	8.90E-03	7.17E-03	6.89E-03
α_4			5.94E-03	5.38E-03	4.38E-03
α_5				2.39E-03	3.13E-03
α_6					1.00E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.69E-01	9.69E-01	9.70E-01	9.71E-01	9.72E-01
Beta	3.09E-02	3.13E-02	2.97E-02	2.87E-02	2.78E-02
Gamma		5.00E-01	5.00E-01	5.21E-01	5.54E-01
Delta			4.00E-01	5.20E-01	5.53E-01
Epsilon				3.08E-01	4.85E-01
Mu					2.42E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	39.87	59.80	79.73	99.67	119.60
N_1	2.0000	2.0000	2.0000	1.8750	1.6875
N_2	1.3333	1.0000	1.2500	1.4375	1.5469
N_3		1.0000	0.7500	0.7500	0.8594
N_4			0.5000	0.5625	0.5469
N_5				0.2500	0.3906
N_6					0.1250

1.3.8.3 STANDBY SERVICE WATER MDP FAIL TO START

System : Standby service water
Component : Motor Driven Pump
Failure Mode : Fail to start
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 122.90
Total Number of Common-Cause Failure Events: 7

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9500100	0.9808940	0.9849600	0.9978720	0.9844550	7.3938E+01	1.4402E+00
α_2	2.12E-03	1.91E-02	1.50E-02	5.00E-02	1.55E-02	1.4402E+00	7.3938E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9407590	0.9693820	0.9718250	0.9896370	0.9710770	1.2246E+02	3.8679E+00
α_2	8.59E-03	2.75E-02	2.51E-02	5.48E-02	2.76E-02	3.4757E+00	1.2285E+02
α_3	2.83E-06	3.10E-03	1.11E-03	1.30E-02	1.31E-03	3.9222E-01	1.2594E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9396600	0.9651050	0.9668710	0.9845100	0.9665350	1.6806E+02	6.0765E+00
α_2	1.01E-02	2.66E-02	2.48E-02	4.92E-02	2.70E-02	4.6370E+00	1.6950E+02
α_3	4.77E-04	6.63E-03	4.86E-03	1.88E-02	5.95E-03	1.1543E+00	1.7298E+02
α_4	1.09E-07	1.64E-03	3.68E-04	7.61E-03	4.95E-04	2.8517E-01	1.7385E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9487440	0.9684930	0.9697030	0.9841070	0.9710280	2.4818E+02	8.0739E+00
α_2	6.90E-03	1.81E-02	1.69E-02	3.36E-02	1.62E-02	4.6496E+00	2.5160E+02
α_3	2.32E-03	9.91E-03	8.67E-03	2.18E-02	9.98E-03	2.5400E+00	2.5371E+02
α_4	7.74E-05	3.05E-03	1.89E-03	9.95E-03	2.60E-03	7.8069E-01	2.5547E+02
α_5	6.55E-16	4.04E-04	2.96E-06	2.34E-03	2.00E-04	1.0358E-01	2.5615E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9531050	0.9704860	0.9714980	0.9844080	0.9742370	2.9903E+02	9.0938E+00
α_2	4.90E-03	1.37E-02	1.27E-02	2.61E-02	1.07E-02	4.2312E+00	3.0389E+02
α_3	2.48E-03	9.36E-03	8.32E-03	1.98E-02	9.33E-03	2.8851E+00	3.0524E+02
α_4	5.11E-04	4.67E-03	3.65E-03	1.23E-02	4.52E-03	1.4377E+00	3.0669E+02
α_5	2.77E-06	1.43E-03	5.79E-04	5.74E-03	1.17E-03	4.4100E-01	3.0768E+02
α_6	1.35E-16	3.21E-04	1.78E-06	1.86E-03	8.35E-05	9.8837E-02	3.0802E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9844550	0.9710770	0.9665350	0.9710280	0.9742370
α_2	1.55E-02	2.76E-02	2.70E-02	1.62E-02	1.07E-02
α_3		1.31E-03	5.95E-03	9.98E-03	9.33E-03
α_4			4.95E-04	2.60E-03	4.52E-03
α_5				2.00E-04	1.17E-03
α_6					8.35E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.84E-01	9.71E-01	9.67E-01	9.71E-01	9.74E-01
Beta	1.55E-02	2.89E-02	3.35E-02	2.90E-02	2.58E-02
Gamma		4.52E-02	1.92E-01	4.41E-01	5.86E-01
Delta			7.69E-02	2.19E-01	3.83E-01
Epsilon				7.15E-02	2.17E-01
Mu					6.66E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	59.37	89.06	118.74	148.43	178.12
N_1	4.3220	3.8411	3.1821	3.5851	3.9665
N_2	1.0057	2.6420	3.4089	2.5354	1.9920
N_3		0.1250	0.7500	1.5626	1.7433
N_4			0.0625	0.4063	0.8455
N_5				0.0313	0.2188
N_6					0.0156

1.3.8.4 STANDBY SERVICE WATER MDP FAIL TO RUN

System : Standby service water
Component : Motor Driven Pump
Failure Mode : Fail to Run (Normally running equipment)
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 3.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8734960	0.9682380	0.9867710	0.9999360	1.0000000	1.3246E+01	4.3452E-01
α_2	5.92E-05	3.18E-02	1.32E-02	1.27E-01	0.00E+00	4.3452E-01	1.3246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9068390	0.9672900	0.9760300	0.9978250	1.0000000	3.2555E+01	1.1009E+00
α_2	7.91E-04	2.48E-02	1.62E-02	7.82E-02	0.00E+00	8.3366E-01	3.2822E+01
α_3	2.80E-07	7.94E-03	1.61E-03	3.77E-02	0.00E+00	2.6722E-01	3.3389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9130680	0.9636200	0.9695110	0.9939910	1.0000000	4.9136E+01	1.8551E+00
α_2	2.00E-03	2.41E-02	1.82E-02	6.63E-02	0.00E+00	1.2281E+00	4.9763E+01
α_3	8.95E-06	7.93E-03	2.95E-03	3.27E-02	0.00E+00	4.0431E-01	5.0587E+01
α_4	1.89E-08	4.37E-03	5.99E-04	2.19E-02	0.00E+00	2.2267E-01	5.0768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9318350	0.9655480	0.9685320	0.9890570	1.0000000	9.9161E+01	3.5382E+00
α_2	3.97E-03	2.06E-02	1.76E-02	4.76E-02	0.00E+00	2.1142E+00	1.0059E+02
α_3	4.65E-04	9.52E-03	6.58E-03	2.86E-02	0.00E+00	9.7738E-01	1.0172E+02
α_4	2.40E-06	3.65E-03	1.23E-03	1.55E-02	0.00E+00	3.7439E-01	1.0232E+02
α_5	5.81E-21	7.04E-04	3.98E-07	4.08E-03	0.00E+00	7.2277E-02	1.0263E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9351640	0.9655550	0.9680290	0.9874920	1.0000000	1.1994E+02	4.2787E+00
α_2	3.71E-03	1.80E-02	1.55E-02	4.10E-02	0.00E+00	2.2392E+00	1.2198E+02
α_3	6.48E-04	9.19E-03	6.73E-03	2.62E-02	0.00E+00	1.1418E+00	1.2308E+02
α_4	4.26E-05	4.77E-03	2.50E-03	1.72E-02	0.00E+00	5.9222E-01	1.2363E+02
α_5	7.48E-09	1.79E-03	2.43E-04	8.96E-03	0.00E+00	2.2220E-01	1.2400E+02
α_6	1.14E-18	6.70E-04	1.17E-06	3.91E-03	0.00E+00	8.3237E-02	1.2414E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	3.00	3.00	3.00	3.00	3.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.3.8.5 SERVICE WATER MDP FAIL TO START SPAR:ESW-MDP-FS

System :	Normally operating service water
	Standby service water
Component :	Motor Driven Pump
Failure Mode :	Fail to start
Prox. Cause :	State of other component
	Design error or inadequacy
	Manufacturing error or inadequacy
	Construction installation error or inadequacy
	Setpoint drift
	Ambient environmental stress
	Inadequate procedure
	Inadequate maintenance
	Age or Wear
	Accidental human action
	Human action procedure
	Other
	Internal environment
	Internal to component; piece-part
	Unknown
Filter Indep. by Cause? :	True
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 148.40
Total Number of Common-Cause Failure Events: 8

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9584500	0.9840830	0.9874520	0.9981980	0.9873550	9.0068E+01	1.4568E+00
α_2	1.80E-03	1.59E-02	1.25E-02	4.16E-02	1.26E-02	1.4568E+00	9.0068E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9497290	0.9739700	0.9760450	0.9911290	0.9764970	1.4660E+02	3.9179E+00
α_2	7.38E-03	2.34E-02	2.13E-02	4.66E-02	2.25E-02	3.5257E+00	1.4699E+02
α_3	2.37E-06	2.61E-03	9.27E-04	1.09E-02	1.04E-03	3.9222E-01	1.5013E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9483810	0.9700820	0.9715860	0.9866380	0.9727290	2.0019E+02	6.1741E+00
α_2	8.83E-03	2.29E-02	2.14E-02	4.23E-02	2.21E-02	4.7333E+00	2.0163E+02
α_3	4.04E-04	5.60E-03	4.11E-03	1.59E-02	4.74E-03	1.1556E+00	2.0521E+02
α_4	9.20E-08	1.38E-03	3.10E-04	6.42E-03	3.95E-04	2.8517E-01	2.0608E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9549600	0.9722320	0.9732850	0.9858990	0.9761430	2.8826E+02	8.2331E+00
α_2	6.28E-03	1.62E-02	1.51E-02	2.98E-02	1.37E-02	4.8052E+00	2.9169E+02
α_3	2.01E-03	8.58E-03	7.50E-03	1.88E-02	7.96E-03	2.5436E+00	2.9395E+02
α_4	6.68E-05	2.63E-03	1.63E-03	8.61E-03	2.06E-03	7.8069E-01	2.9571E+02
α_5	5.66E-16	3.49E-04	2.56E-06	2.02E-03	1.59E-04	1.0358E-01	2.9639E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9585870	0.9738230	0.9747020	0.9860530	0.9785250	3.4703E+02	9.3283E+00
α_2	4.62E-03	1.25E-02	1.16E-02	2.35E-02	9.44E-03	4.4581E+00	3.5190E+02
α_3	2.15E-03	8.12E-03	7.22E-03	1.72E-02	7.45E-03	2.8926E+00	3.5347E+02
α_4	4.42E-04	4.03E-03	3.15E-03	1.06E-02	3.60E-03	1.4378E+00	3.5492E+02
α_5	2.40E-06	1.24E-03	5.00E-04	4.97E-03	9.31E-04	4.4100E-01	3.5592E+02
α_6	1.17E-16	2.77E-04	1.54E-06	1.61E-03	6.63E-05	9.8837E-02	3.5626E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9873550	0.9764970	0.9727290	0.9761430	0.9785250
α_2	1.26E-02	2.25E-02	2.21E-02	1.37E-02	9.44E-03
α_3		1.04E-03	4.74E-03	7.96E-03	7.45E-03
α_4			3.95E-04	2.06E-03	3.60E-03
α_5				1.59E-04	9.31E-04
α_6					6.63E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.87E-01	9.76E-01	9.73E-01	9.76E-01	9.79E-01
Beta	1.26E-02	2.35E-02	2.73E-02	2.39E-02	2.15E-02
Gamma		4.44E-02	1.88E-01	4.27E-01	5.61E-01
Delta			7.68E-02	2.18E-01	3.82E-01
Epsilon				7.15E-02	2.17E-01
Mu					6.66E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	74.20	111.30	148.40	185.50	222.60
N_1	5.6220	5.7411	5.6521	6.5954	7.4886
N_2	1.0223	2.6920	3.5052	2.6910	2.2189
N_3		0.1250	0.7513	1.5662	1.7508
N_4			0.0625	0.4063	0.8456
N_5				0.0313	0.2188
N_6					0.0156

1.3.8.6 SERVICE WATER MDP FAIL TO RUN SPAR:ESW-MDP-FR

System :	Normally operating service water
	Standby service water
Component :	Motor Driven Pump
Failure Mode :	Fail to Run (Normally running equipment)
Prox. Cause :	State of other component
	Design error or inadequacy
	Manufacturing error or inadequacy
	Construction installation error or inadequacy
	Setpoint drift
	Ambient environmental stress
	Inadequate procedure
	Inadequate maintenance
	Age or Wear
	Accidental human action
	Human action procedure
	Other
	Internal environment
	Internal to component; piece-part
	Unknown
Filter Indep. by Cause? :	True
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 61.70
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9291160	0.9728370	0.9785580	0.9969830	0.9762640	5.1376E+01	1.4345E+00
α_2	3.02E-03	2.72E-02	2.14E-02	7.09E-02	2.37E-02	1.4345E+00	5.1376E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9479540	0.9774960	0.9808160	0.9956930	0.9840510	9.1255E+01	2.1009E+00
α_2	2.80E-04	8.93E-03	5.75E-03	2.84E-02	0.00E+00	8.3366E-01	9.2522E+01
α_3	1.19E-03	1.36E-02	1.03E-02	3.72E-02	1.59E-02	1.2672E+00	9.2089E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9540900	0.9782490	0.9806350	0.9942600	0.9879910	1.2841E+02	2.8551E+00
α_2	7.68E-04	9.36E-03	7.01E-03	2.60E-02	0.00E+00	1.2281E+00	1.3004E+02
α_3	2.73E-04	6.89E-03	4.60E-03	2.13E-02	6.00E-03	9.0431E-01	1.3036E+02
α_4	1.08E-04	5.51E-03	3.28E-03	1.85E-02	6.00E-03	7.2267E-01	1.3054E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9584780	0.9777020	0.9792470	0.9916410	0.9903690	1.9899E+02	4.5383E+00
α_2	1.99E-03	1.04E-02	8.83E-03	2.41E-02	0.00E+00	2.1142E+00	2.0141E+02
α_3	4.93E-04	6.03E-03	4.51E-03	1.68E-02	2.41E-03	1.2274E+00	2.0230E+02
α_4	1.54E-04	4.30E-03	2.82E-03	1.35E-02	4.82E-03	8.7439E-01	2.0265E+02
α_5	3.20E-07	1.58E-03	4.33E-04	7.07E-03	2.41E-03	3.2228E-01	2.0321E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9614370	0.9785090	0.9797930	0.9911910	0.9919610	2.4034E+02	5.2787E+00
α_2	1.86E-03	9.12E-03	7.82E-03	2.08E-02	0.00E+00	2.2392E+00	2.4338E+02
α_3	4.48E-04	5.16E-03	3.89E-03	1.42E-02	1.00E-03	1.2668E+00	2.4435E+02
α_4	1.86E-04	3.94E-03	2.70E-03	1.19E-02	3.01E-03	9.6722E-01	2.4465E+02
α_5	2.25E-05	2.43E-03	1.28E-03	8.75E-03	3.01E-03	5.9720E-01	2.4502E+02
α_6	1.51E-09	8.48E-04	9.79E-05	4.32E-03	1.00E-03	2.0824E-01	2.4541E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9762640	0.9840510	0.9879910	0.9903690	0.9919610
α_2	2.37E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		1.59E-02	6.00E-03	2.41E-03	1.00E-03
α_4			6.00E-03	4.82E-03	3.01E-03
α_5				2.41E-03	3.01E-03
α_6					1.00E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.76E-01	9.84E-01	9.88E-01	9.90E-01	9.92E-01
Beta	2.37E-02	1.59E-02	1.20E-02	9.63E-03	8.04E-03
Gamma		1.00E+00	1.00E+00	1.00E+00	1.00E+00
Delta			5.00E-01	7.50E-01	8.75E-01
Epsilon				3.33E-01	5.71E-01
Mu					2.50E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	41.13	61.70	82.27	102.83	123.40
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	1.0000	0.0000	0.0000	0.0000	0.0000
N_3		1.0000	0.5000	0.2500	0.1250
N_4			0.5000	0.5000	0.3750
N_5				0.2500	0.3750
N_6					0.1250

1.3.9 PWR High Pressure Safety Injection Pump

1.3.9.1 HIGH PRESSURE INJECTION MOTOR DRIVEN PUMP FAIL TO START

System : Chemical and volume control
High pressure injection
Component : Motor Driven Pump
Failure Mode : Fail to start
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 157.10
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9776190	0.9915010	0.9933460	0.9990670	0.9936750	1.6735E+02	1.4345E+00
α_2	9.31E-04	8.50E-03	6.65E-03	2.24E-02	6.33E-03	1.4345E+00	1.6735E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9817080	0.9921400	0.9933310	0.9985110	0.9957740	2.6520E+02	2.1009E+00
α_2	4.78E-04	4.99E-03	3.82E-03	1.35E-02	2.11E-03	1.3337E+00	2.6597E+02
α_3	6.88E-05	2.87E-03	1.76E-03	9.44E-03	2.11E-03	7.6722E-01	2.6653E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9833200	0.9921390	0.9930260	0.9979450	0.9968270	3.6034E+02	2.8551E+00
α_2	4.67E-04	4.07E-03	3.20E-03	1.06E-02	7.93E-04	1.4781E+00	3.6172E+02
α_3	9.83E-05	2.49E-03	1.66E-03	7.72E-03	1.59E-03	9.0431E-01	3.6229E+02
α_4	3.78E-06	1.30E-03	5.63E-04	5.10E-03	7.93E-04	4.7267E-01	3.6272E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9936750	0.9957740	0.9968270
α_2	6.33E-03	2.11E-03	7.93E-04
α_3		2.11E-03	1.59E-03
α_4			7.93E-04

HIGH PRESSURE INJECTION MOTOR DRIVEN PUMP FTR LESS THAN 1H

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.94E-01	9.96E-01	9.97E-01
Beta	6.33E-03	4.23E-03	3.17E-03
Gamma		5.00E-01	7.50E-01
Delta			3.33E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	157.10	235.65	314.20
N_1	0.0000	0.0000	0.0000
N_2	1.0000	0.5000	0.2500
N_3		0.5000	0.5000
N_4			0.2500

1.3.9.2 HIGH PRESSURE INJECTION MOTOR DRIVEN PUMP FTR LESS THAN 1H

System :	Chemical and volume control High pressure injection
Component :	Motor Driven Pump
Failure Mode :	Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 2.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8687700	0.9670330	0.9862440	0.9999400	1.0000000	1.2746E+01	4.3452E-01
α_2	6.16E-05	3.30E-02	1.38E-02	1.31E-01	0.00E+00	4.3452E-01	1.2746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9054640	0.9667970	0.9756610	0.9977910	1.0000000	3.2055E+01	1.1009E+00
α_2	8.04E-04	2.51E-02	1.64E-02	7.93E-02	0.00E+00	8.3366E-01	3.2322E+01
α_3	2.84E-07	8.06E-03	1.63E-03	3.82E-02	0.00E+00	2.6722E-01	3.2889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9122220	0.9632590	0.9692100	0.9939300	1.0000000	4.8636E+01	1.8551E+00
α_2	2.02E-03	2.43E-02	1.84E-02	6.70E-02	0.00E+00	1.2281E+00	4.9263E+01
α_3	9.04E-06	8.01E-03	2.98E-03	3.31E-02	0.00E+00	4.0431E-01	5.0087E+01
α_4	1.91E-08	4.41E-03	6.05E-04	2.21E-02	0.00E+00	2.2267E-01	5.0268E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	2.50	2.50	2.50
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.3.9.3 HIGH PRESSURE INJECTION MOTOR DRIVEN PUMP FAIL TO RUN

System : Chemical and volume control
High pressure injection
Component : Motor Driven Pump
Failure Mode : Fail to Run (Normally running equipment)
Fail to Run >1 Hour (Standby equipment)
Fail to Run less than 1 Hour
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 149.90
Total Number of Common-Cause Failure Events: 5

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9586650	0.9813360	0.9837400	0.9957970	0.9833000	1.2802E+02	2.4348E+00
α_2	4.21E-03	1.87E-02	1.63E-02	4.13E-02	1.67E-02	2.4348E+00	1.2802E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9590530	0.9779350	0.9794440	0.9916570	0.9803210	2.0396E+02	4.6019E+00
α_2	5.47E-03	1.72E-02	1.57E-02	3.41E-02	1.55E-02	3.5847E+00	2.0498E+02
α_3	2.62E-04	4.88E-03	3.41E-03	1.45E-02	4.22E-03	1.0172E+00	2.0754E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9636710	0.9792190	0.9803330	0.9909620	0.9828560	2.7796E+02	5.8988E+00
α_2	3.32E-03	1.14E-02	1.03E-02	2.33E-02	8.49E-03	3.2301E+00	2.8063E+02
α_3	1.36E-03	7.30E-03	6.18E-03	1.71E-02	7.07E-03	2.0710E+00	2.8179E+02
α_4	1.95E-05	2.11E-03	1.11E-03	7.58E-03	1.59E-03	5.9767E-01	2.8326E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9833000	0.9803210	0.9828560
α_2	1.67E-02	1.55E-02	8.49E-03
α_3		4.22E-03	7.07E-03
α_4			1.59E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.83E-01	9.80E-01	9.83E-01
Beta	1.67E-02	1.97E-02	1.71E-02
Gamma		2.14E-01	5.05E-01
Delta			1.84E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	115.31	172.96	230.62
N_1	2.4660	1.4480	1.2071
N_2	2.0003	2.7510	2.0020
N_3		0.7500	1.6667
N_4			0.3750

1.3.9.4 HIGH PRESSURE INJECTION MOTOR DRIVEN PUMP FAIL TO RUN >1H

System :	Chemical and volume control High pressure injection
Component :	Motor Driven Pump
Failure Mode :	Fail to Run (Normally running equipment) Fail to Run >1 Hour (Standby equipment)
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 147.40
Total Number of Common-Cause Failure Events: 5

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9580500	0.9810560	0.9834950	0.9957330	0.9830260	1.2609E+02	2.4348E+00
α_2	4.27E-03	1.89E-02	1.65E-02	4.19E-02	1.70E-02	2.4348E+00	1.2609E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9584880	0.9776260	0.9791550	0.9915390	0.9799980	2.0108E+02	4.6019E+00
α_2	5.54E-03	1.74E-02	1.59E-02	3.46E-02	1.57E-02	3.5847E+00	2.0210E+02
α_3	2.66E-04	4.95E-03	3.46E-03	1.47E-02	4.29E-03	1.0172E+00	2.0466E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9631700	0.9789340	0.9800620	0.9908370	0.9825720	2.7411E+02	5.8988E+00
α_2	3.37E-03	1.15E-02	1.04E-02	2.36E-02	8.63E-03	3.2301E+00	2.7678E+02
α_3	1.38E-03	7.40E-03	6.26E-03	1.73E-02	7.18E-03	2.0710E+00	2.7794E+02
α_4	1.98E-05	2.13E-03	1.12E-03	7.68E-03	1.62E-03	5.9767E-01	2.7941E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9830260	0.9799980	0.9825720
α_2	1.70E-02	1.57E-02	8.63E-03
α_3		4.29E-03	7.18E-03
α_4			1.62E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.83E-01	9.80E-01	9.83E-01
Beta	1.70E-02	2.00E-02	1.74E-02
Gamma		2.14E-01	5.05E-01
Delta			1.84E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	113.38	170.08	226.77
N_1	2.4660	1.4480	1.2071
N_2	2.0003	2.7510	2.0020
N_3		0.7500	1.6667
N_4			0.3750

1.3.10 PWR Residual Heat Removal Pump

1.3.10.1 PWR RHR MDP FAIL TO START

System : Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component : Motor Driven Pump
Failure Mode : Fail to start
Op. Mode : CCF Event Can Only Happen During Power Operation
CCF Event May Occur During Both Power Operation & Shutdown
Plant Type : PWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 33.50
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9048220	0.9619520	0.9690180	0.9948830	0.9628450	4.0566E+01	1.6045E+00
α_2	5.12E-03	3.80E-02	3.10E-02	9.52E-02	3.72E-02	1.6045E+00	4.0566E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9281530	0.9668900	0.9708430	0.9920950	0.9687360	7.4600E+01	2.5546E+00
α_2	3.47E-03	2.28E-02	1.88E-02	5.58E-02	1.99E-02	1.7592E+00	7.5395E+01
α_3	2.80E-04	1.03E-02	6.50E-03	3.33E-02	1.14E-02	7.9542E-01	7.6359E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9344890	0.9666210	0.9694270	0.9891500	0.9707450	1.0574E+02	3.6514E+00
α_2	3.94E-03	1.98E-02	1.70E-02	4.55E-02	1.53E-02	2.1700E+00	1.0722E+02
α_3	4.79E-04	9.17E-03	6.41E-03	2.73E-02	9.76E-03	1.0036E+00	1.0839E+02
α_4	1.35E-05	4.37E-03	1.92E-03	1.70E-02	4.15E-03	4.7777E-01	1.0891E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9628450	0.9687360	0.9707450
α_2	3.72E-02	1.99E-02	1.53E-02
α_3		1.14E-02	9.76E-03
α_4			4.15E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.63E-01	9.69E-01	9.71E-01
Beta	3.72E-02	3.13E-02	2.93E-02
Gamma		3.63E-01	4.76E-01
Delta			2.99E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	28.76	43.13	57.51
N_1	1.5600	1.9145	2.0960
N_2	1.1700	0.9255	0.9419
N_3		0.5282	0.5993
N_4			0.2551

1.3.10.2 PWR RHR MDP FTR LESS THAN 1H

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Motor Driven Pump
Failure Mode :	Fail to Run less than 1 Hour
Op. Mode :	CCF Event Can Only Happen During Power Operation CCF Event May Occur During Both Power Operation & Shutdown
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 3.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.7543360	0.9022850	0.9202640	0.9884770	0.7500000	1.3246E+01	1.4345E+00
α_2	1.15E-02	9.77E-02	7.97E-02	2.46E-01	2.50E-01	1.4345E+00	1.3246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8677700	0.9418930	0.9498900	0.9886020	0.8181820	3.4055E+01	2.1009E+00
α_2	3.63E-03	3.69E-02	2.87E-02	9.82E-02	9.09E-02	1.3337E+00	3.4822E+01
α_3	5.20E-04	2.12E-02	1.32E-02	6.91E-02	9.09E-02	7.6722E-01	3.5389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8917500	0.9480810	0.9534430	0.9860670	0.8571430	5.2136E+01	2.8551E+00
α_2	3.14E-03	2.69E-02	2.14E-02	6.95E-02	3.57E-02	1.4781E+00	5.3513E+01
α_3	6.59E-04	1.64E-02	1.11E-02	5.06E-02	7.14E-02	9.0431E-01	5.4087E+01
α_4	2.52E-05	8.60E-03	3.76E-03	3.36E-02	3.57E-02	4.7267E-01	5.4518E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.7500000	0.8181820	0.8571430
α_2	2.50E-01	9.09E-02	3.57E-02
α_3		9.09E-02	7.14E-02
α_4			3.57E-02

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	7.50E-01	8.18E-01	8.57E-01
Beta	2.50E-01	1.82E-01	1.43E-01
Gamma		5.00E-01	7.50E-01
Delta			3.33E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	3.00	4.50	6.00
N_1	0.0000	0.0000	0.0000
N_2	1.0000	0.5000	0.2500
N_3		0.5000	0.5000
N_4			0.2500

1.3.10.3 PWR RHR MDP FAIL TO RUN

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Motor Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment) Fail to Run less than 1 Hour
Op. Mode :	CCF Event Can Only Happen During Power Operation CCF Event May Occur During Both Power Operation & Shutdown
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 12.90
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8501120	0.9416410	0.9532510	0.9933410	0.9280580	2.3146E+01	1.4345E+00
α_2	6.66E-03	5.84E-02	4.67E-02	1.50E-01	7.19E-02	1.4345E+00	2.3146E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9055390	0.9588100	0.9646690	0.9920110	0.9508600	4.8905E+01	2.1009E+00
α_2	2.55E-03	2.61E-02	2.02E-02	7.00E-02	2.46E-02	1.3337E+00	4.9672E+01
α_3	3.66E-04	1.50E-02	9.34E-03	4.92E-02	2.46E-02	7.6722E-01	5.0239E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9199550	0.9618260	0.9658780	0.9898350	0.9626870	7.1936E+01	2.8551E+00
α_2	2.30E-03	1.98E-02	1.57E-02	5.12E-02	9.33E-03	1.4781E+00	7.3313E+01
α_3	4.82E-04	1.21E-02	8.10E-03	3.73E-02	1.87E-02	9.0431E-01	7.3887E+01
α_4	1.85E-05	6.32E-03	2.75E-03	2.47E-02	9.33E-03	4.7267E-01	7.4318E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9280580	0.9508600	0.9626870
α_2	7.19E-02	2.46E-02	9.33E-03
α_3		2.46E-02	1.87E-02
α_4			9.33E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.28E-01	9.51E-01	9.63E-01
Beta	7.19E-02	4.91E-02	3.73E-02
Gamma		5.00E-01	7.50E-01
Delta			3.33E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	12.90	19.35	25.80
N_1	0.0000	0.0000	0.0000
N_2	1.0000	0.5000	0.2500
N_3		0.5000	0.5000
N_4			0.2500

1.3.10.4 PWR RHR MDP FAIL TO RUN >1H

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Motor Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment)
Op. Mode :	CCF Event Can Only Happen During Power Operation CCF Event May Occur During Both Power Operation & Shutdown
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 9.90
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9154950	0.9788870	0.9913450	0.9999580	1.0000000	2.0146E+01	4.3452E-01
α_2	3.86E-05	2.11E-02	8.65E-03	8.45E-02	0.00E+00	4.3452E-01	2.0146E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9224660	0.9728550	0.9801750	0.9982080	1.0000000	3.9455E+01	1.1009E+00
α_2	6.54E-04	2.06E-02	1.34E-02	6.50E-02	0.00E+00	8.3366E-01	3.9722E+01
α_3	2.31E-07	6.59E-03	1.33E-03	3.13E-02	0.00E+00	2.6722E-01	4.0289E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9232780	0.9679560	0.9731900	0.9947240	1.0000000	5.6036E+01	1.8551E+00
α_2	1.76E-03	2.12E-02	1.60E-02	5.85E-02	0.00E+00	1.2281E+00	5.6663E+01
α_3	7.87E-06	6.98E-03	2.59E-03	2.88E-02	0.00E+00	4.0431E-01	5.7487E+01
α_4	1.66E-08	3.85E-03	5.27E-04	1.93E-02	0.00E+00	2.2267E-01	5.7668E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	9.90	9.90	9.90
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.3.11 BWR Standby Liquid Control Pump

1.3.11.1 STANDBY LIQUID CONTROL MDP FAIL TO START SPAR: SLC-MDP-FS

System :	Standby liquid control
Component :	Motor Driven Pump
Failure Mode :	Fail to start
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 14.50
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9303290	0.9824790	0.9926940	0.9999600	0.9993190	2.4926E+01	4.4452E-01
α_2	3.66E-05	1.75E-02	7.31E-03	6.97E-02	6.81E-04	4.4452E-01	2.4926E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	0.9993190
α_2	6.81E-04

MGL Parameter	CCCG=2
1-Beta	9.99E-01
Beta	6.81E-04

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	14.50
N_1	0.1800
N_2	0.0100

1.3.11.2 STANDBY LIQUID CONTROL MDP FAIL TO RUN SPAR: SLC-MDP-FR

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Motor Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment) Fail to Run less than 1 Hour
Op. Mode :	CCF Event Can Only Happen During Power Operation CCF Event May Occur During Both Power Operation & Shutdown
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 12.90
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8501120	0.9416410	0.9532510	0.9933410	0.9280580	2.3146E+01	1.4345E+00
α_2	6.66E-03	5.84E-02	4.67E-02	1.50E-01	7.19E-02	1.4345E+00	2.3146E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	0.9280580
α_2	7.19E-02

MGL Parameter	CCCG=2
1-Beta	9.28E-01
Beta	7.19E-02

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	12.90
N_1	0.0000
N_2	1.0000

1.3.11.3 STANDBY LIQUID CONTROL MDP FAIL TO RUN >1H

System :	Standby liquid control
Component :	Motor Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment)
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 2.20
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8657670	0.9662650	0.9859070	0.9999390	1.0000000	1.2446E+01	4.3452E-01
α_2	6.31E-05	3.37E-02	1.41E-02	1.34E-01	0.00E+00	4.3452E-01	1.2446E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	1.0000000
α_2	0.00E+00

MGL Parameter	CCCG=2
1-Beta	1.00E+00
Beta	0.00E+00

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	2.20
N_1	0.0000
N_2	0.0000

1.3.12 Component Cooling Water Pumps

1.3.12.1 CCW MOTOR DRIVEN PUMP FAIL TO START SPAR: CCW-MDP-FS

System :	Component cooling water
Component :	Motor Driven Pump
Failure Mode :	Fail to start
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 84.70
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9816430	0.9954440	0.9981810	0.9999930	1.0000000	9.4946E+01	4.3452E-01
α_2	8.11E-06	4.56E-03	1.82E-03	1.84E-02	0.00E+00	4.3452E-01	9.4946E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9724940	0.9904560	0.9931000	0.9993770	1.0000000	1.1425E+02	1.1009E+00
α_2	2.27E-04	7.23E-03	4.65E-03	2.30E-02	0.00E+00	8.3366E-01	1.1452E+02
α_3	8.05E-08	2.32E-03	4.63E-04	1.10E-02	0.00E+00	2.6722E-01	1.1508E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3
α_1	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00
α_3		0.00E+00

MGL Parameter	CCCG=2	CCCG=3
1-Beta	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00
Gamma		0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3
Adj. Ind. Events	84.70	84.70
N_1	0.0000	0.0000
N_2	0.0000	0.0000
N_3		0.0000

1.3.12.2 CCW MOTOR DRIVEN PUMP FAIL TO RUN SPAR: CCW-MDP-FR

System :	Component cooling water
Component :	Motor Driven Pump
Failure Mode :	Fail to Run (Normally running equipment)
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 59.50
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9167990	0.9674270	0.9738680	0.9960030	0.9698380	4.5079E+01	1.5178E+00
α_2	4.00E-03	3.26E-02	2.61E-02	8.32E-02	3.02E-02	1.5178E+00	4.5079E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9375400	0.9719820	0.9756490	0.9938790	0.9765260	8.1555E+01	2.3509E+00
α_2	8.13E-04	1.29E-02	9.30E-03	3.74E-02	4.69E-03	1.0837E+00	8.2822E+01
α_3	1.32E-03	1.51E-02	1.15E-02	4.13E-02	1.88E-02	1.2672E+00	8.2639E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3
α_1	0.9698380	0.9765260
α_2	3.02E-02	4.69E-03
α_3		1.88E-02

MGL Parameter	CCCG=2	CCCG=3
1-Beta	9.70E-01	9.77E-01
Beta	3.02E-02	2.35E-02
Gamma		8.00E-01

Avg. Impact Vector	CCCG=2	CCCG=3
Adj. Ind. Events	34.00	51.00
N_1	0.8333	1.0000
N_2	1.0833	0.2500
N_3		1.0000

1.3.13 Positive Displacement Pumps

1.3.13.1 POSITIVE DISPLACEMENT PUMP FAIL TO START

Component :	Motor Driven Pump
Failure Mode :	Fail to start
Component Group :	Positive Displacement
Start Date :	1998/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 99.60
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9839120	0.9959760	0.9983560	0.9999930	0.9999000	1.1003E+02	4.4452E-01
α_2	8.21E-06	4.02E-03	1.65E-03	1.61E-02	1.00E-04	4.4452E-01	1.1003E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9820820	0.9937400	0.9954430	0.9995680	0.9998130	1.7920E+02	1.1289E+00
α_2	1.64E-04	4.77E-03	3.11E-03	1.50E-02	1.80E-04	8.6066E-01	1.7947E+02
α_3	5.36E-08	1.49E-03	2.99E-04	7.05E-03	6.68E-06	2.6822E-01	1.8006E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9815060	0.9922950	0.9935710	0.9987070	0.9997380	2.4563E+02	1.9074E+00
α_2	4.55E-04	5.16E-03	3.90E-03	1.42E-02	2.44E-04	1.2767E+00	2.4626E+02
α_3	1.95E-06	1.65E-03	6.13E-04	6.80E-03	1.80E-05	4.0791E-01	2.4713E+02
α_4	3.88E-09	9.00E-04	1.23E-04	4.50E-03	5.01E-07	2.2277E-01	2.4731E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9999000	0.9998130	0.9997380
α_2	1.00E-04	1.80E-04	2.44E-04
α_3		6.68E-06	1.80E-05
α_4			5.01E-07

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	1.00E-04	1.87E-04	2.62E-04
Gamma		3.57E-02	7.07E-02
Delta			2.70E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	99.60	149.40	199.20
N_1	0.1800	0.2430	0.2916
N_2	0.0100	0.0270	0.0486
N_3		0.0010	0.0036
N_4			0.0001

1.3.13.2 POSITIVE DISPLACEMENT PUMP FAIL TO RUN

Component :	Motor Driven Pump
Failure Mode :	Fail to Run (Normally running equipment)
Component Group :	Positive Displacement
Start Date :	1998/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 97.30
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9618470	0.9860710	0.9894360	0.9987750	0.9896280	8.9753E+01	1.2678E+00
α_2	1.22E-03	1.39E-02	1.06E-02	3.82E-02	1.04E-02	1.2678E+00	8.9753E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9574140	0.9793510	0.9814390	0.9941470	0.9832650	1.4707E+02	3.1009E+00
α_2	4.12E-03	1.72E-02	1.51E-02	3.75E-02	1.46E-02	2.5837E+00	1.4759E+02
α_3	1.62E-05	3.44E-03	1.62E-03	1.31E-02	2.09E-03	5.1722E-01	1.4965E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9611550	0.9795200	0.9810470	0.9926680	0.9850210	2.0232E+02	4.2301E+00
α_2	2.74E-03	1.20E-02	1.05E-02	2.65E-02	7.88E-03	2.4781E+00	2.0407E+02
α_3	7.16E-04	6.80E-03	5.29E-03	1.80E-02	6.31E-03	1.4043E+00	2.0515E+02
α_4	6.32E-07	1.68E-03	5.13E-04	7.33E-03	7.88E-04	3.4767E-01	2.0620E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9896280	0.9832650	0.9850210
α_2	1.04E-02	1.46E-02	7.88E-03
α_3		2.09E-03	6.31E-03
α_4			7.88E-04

POSITIVE DISPLACEMENT PUMP FAIL TO RUN

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.90E-01	9.83E-01	9.85E-01
Beta	1.04E-02	1.67E-02	1.50E-02
Gamma		1.25E-01	4.74E-01
Delta			1.11E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	77.84	116.76	155.68
N_1	1.6667	0.7500	0.5000
N_2	0.8333	1.7500	1.2500
N_3		0.2500	1.0000
N_4			0.1250

1.4 Turbine Driven Pumps

1.4.1 Pooled Turbine Driven Pumps

1.4.1.1 TURBINE DRIVEN PUMP FAIL TO START SPAR: TDP-FS

Component :	Turbine Driven Pump
Failure Mode :	Fail to start
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 183.90
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9806760	0.9926660	0.9942600	0.9991950	0.9945920	1.9415E+02	1.4345E+00
α_2	8.02E-04	7.33E-03	5.74E-03	1.93E-02	5.41E-03	1.4345E+00	1.9415E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9840940	0.9931680	0.9942000	0.9987070	0.9963880	3.0540E+02	2.1009E+00
α_2	4.16E-04	4.34E-03	3.32E-03	1.17E-02	1.81E-03	1.3337E+00	3.0617E+02
α_3	5.98E-05	2.50E-03	1.53E-03	8.21E-03	1.81E-03	7.6722E-01	3.0673E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9854590	0.9931500	0.9939240	0.9982100	0.9972890	4.1394E+02	2.8551E+00
α_2	4.07E-04	3.55E-03	2.79E-03	9.27E-03	6.78E-04	1.4781E+00	4.1532E+02
α_3	8.56E-05	2.17E-03	1.44E-03	6.73E-03	1.36E-03	9.0431E-01	4.1589E+02
α_4	3.29E-06	1.13E-03	4.91E-04	4.44E-03	6.78E-04	4.7267E-01	4.1632E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9945920	0.9963880	0.9972890
α_2	5.41E-03	1.81E-03	6.78E-04
α_3		1.81E-03	1.36E-03
α_4			6.78E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.95E-01	9.96E-01	9.97E-01
Beta	5.41E-03	3.61E-03	2.71E-03
Gamma		5.00E-01	7.50E-01
Delta			3.33E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	183.90	275.85	367.80
N_1	0.0000	0.0000	0.0000
N_2	1.0000	0.5000	0.2500
N_3		0.5000	0.5000
N_4			0.2500

1.4.1.2 TURBINE DRIVEN PUMP FTR LESS THAN 1H

Component :	Turbine Driven Pump
Failure Mode :	Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 66.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9772050	0.9943410	0.9977360	0.9999910	1.0000000	7.6346E+01	4.3452E-01
α_2	1.01E-05	5.66E-03	2.27E-03	2.28E-02	0.00E+00	4.3452E-01	7.6346E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9672370	0.9886220	0.9917700	0.9992560	1.0000000	9.5655E+01	1.1009E+00
α_2	2.70E-04	8.62E-03	5.55E-03	2.74E-02	0.00E+00	8.3366E-01	9.5922E+01
α_3	9.61E-08	2.76E-03	5.53E-04	1.31E-02	0.00E+00	2.6722E-01	9.6489E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9607900	0.9837410	0.9864750	0.9973530	1.0000000	1.1224E+02	1.8551E+00
α_2	8.84E-04	1.08E-02	8.07E-03	2.99E-02	0.00E+00	1.2281E+00	1.1287E+02
α_3	3.97E-06	3.54E-03	1.31E-03	1.47E-02	0.00E+00	4.0431E-01	1.1369E+02
α_4	8.39E-09	1.95E-03	2.66E-04	9.77E-03	0.00E+00	2.2267E-01	1.1387E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	66.10	66.10	66.10
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.4.1.3 TDP FTR LESS THAN AND > 1 HOUR ALL SYSTEMS SPAR: TDP-FR

Component :	Turbine Driven Pump
Failure Mode :	Fail to Run (Normally running equipment) Fail to Run >1 Hour (Standby equipment) Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 154.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9893620	0.9973630	0.9989470	0.9999900	1.0000000	1.6435E+02	4.3452E-01
α_2	4.68E-06	2.64E-03	1.05E-03	1.06E-02	0.00E+00	4.3452E-01	1.6435E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9827910	0.9940410	0.9957010	0.9996110	1.0000000	1.8365E+02	1.1009E+00
α_2	1.41E-04	4.51E-03	2.90E-03	1.44E-02	0.00E+00	8.3366E-01	1.8392E+02
α_3	5.02E-08	1.45E-03	2.89E-04	6.86E-03	0.00E+00	2.6722E-01	1.8448E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9777870	0.9908210	0.9923810	0.9985140	1.0000000	2.0024E+02	1.8551E+00
α_2	4.97E-04	6.08E-03	4.54E-03	1.69E-02	0.00E+00	1.2281E+00	2.0087E+02
α_3	2.24E-06	2.00E-03	7.37E-04	8.28E-03	0.00E+00	4.0431E-01	2.0169E+02
α_4	4.72E-09	1.10E-03	1.50E-04	5.52E-03	0.00E+00	2.2267E-01	2.0187E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9722110	0.9860590	0.9873170	0.9956190	1.0000000	2.5026E+02	3.5382E+00
α_2	1.59E-03	8.33E-03	7.08E-03	1.93E-02	0.00E+00	2.1142E+00	2.5168E+02
α_3	1.87E-04	3.85E-03	2.65E-03	1.16E-02	0.00E+00	9.7738E-01	2.5282E+02
α_4	9.66E-07	1.48E-03	4.95E-04	6.27E-03	0.00E+00	3.7439E-01	2.5342E+02
α_5	2.34E-21	2.85E-04	1.61E-07	1.65E-03	0.00E+00	7.2277E-02	2.5373E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9705600	0.9844590	0.9856150	0.9944030	1.0000000	2.7104E+02	4.2787E+00
α_2	1.66E-03	8.13E-03	6.98E-03	1.86E-02	0.00E+00	2.2392E+00	2.7308E+02
α_3	2.91E-04	4.15E-03	3.03E-03	1.18E-02	0.00E+00	1.1418E+00	2.7418E+02
α_4	1.92E-05	2.15E-03	1.12E-03	7.77E-03	0.00E+00	5.9222E-01	2.7473E+02
α_5	3.37E-09	8.07E-04	1.09E-04	4.04E-03	0.00E+00	2.2220E-01	2.7510E+02
α_6	5.11E-19	3.02E-04	5.28E-07	1.76E-03	0.00E+00	8.3237E-02	2.7524E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	154.10	154.10	154.10	154.10	154.10
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.4.1.4 TURBINE DRIVEN PUMP FAIL TO RUN >1H

Component : Turbine Driven Pump
Failure Mode : Fail to Run (Normally running equipment)
Fail to Run >1 Hour (Standby equipment)
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 88.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9822560	0.9955970	0.9982420	0.9999930	1.0000000	9.8246E+01	4.3452E-01
α_2	7.83E-06	4.40E-03	1.76E-03	1.77E-02	0.00E+00	4.3452E-01	9.8246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9732570	0.9907220	0.9932940	0.9993940	1.0000000	1.1756E+02	1.1009E+00
α_2	2.20E-04	7.03E-03	4.52E-03	2.24E-02	0.00E+00	8.3366E-01	1.1783E+02
α_3	7.82E-08	2.25E-03	4.50E-04	1.07E-02	0.00E+00	2.6722E-01	1.1839E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9670590	0.9863590	0.9886590	0.9977830	1.0000000	1.3414E+02	1.8551E+00
α_2	7.41E-04	9.03E-03	6.76E-03	2.51E-02	0.00E+00	1.2281E+00	1.3477E+02
α_3	3.33E-06	2.97E-03	1.10E-03	1.23E-02	0.00E+00	4.0431E-01	1.3559E+02
α_4	7.03E-09	1.64E-03	2.23E-04	8.20E-03	0.00E+00	2.2267E-01	1.3577E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	88.00	88.00	88.00
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.4.2 AFW Turbine-Driven Pumps

1.4.2.1 AFW TURBINE DRIVEN PUMP FAIL TO START SPAR: AFW-TDP-FS

System :	Auxiliary feedwater
Component :	Turbine Driven Pump
Failure Mode :	Fail to start
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 73.90
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9793040	0.9948630	0.9979470	0.9999920	1.0000000	8.4146E+01	4.3452E-01
α_2	9.15E-06	5.14E-03	2.06E-03	2.07E-02	0.00E+00	4.3452E-01	8.4146E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9696700	0.9894710	0.9923880	0.9993120	1.0000000	1.0346E+02	1.1009E+00
α_2	2.50E-04	7.97E-03	5.13E-03	2.54E-02	0.00E+00	8.3366E-01	1.0373E+02
α_3	8.89E-08	2.56E-03	5.12E-04	1.21E-02	0.00E+00	2.6722E-01	1.0429E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9632810	0.9847810	0.9873450	0.9975240	1.0000000	1.2004E+02	1.8551E+00
α_2	8.27E-04	1.01E-02	7.55E-03	2.80E-02	0.00E+00	1.2281E+00	1.2067E+02
α_3	3.72E-06	3.32E-03	1.22E-03	1.37E-02	0.00E+00	4.0431E-01	1.2149E+02
α_4	7.85E-09	1.83E-03	2.49E-04	9.15E-03	0.00E+00	2.2267E-01	1.2167E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	73.90	73.90	73.90
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.4.2.2 AFW TURBINE DRIVEN PUMP FTR LESS THAN 1H SPAR: AFW-TDP-FH

System :	Auxiliary feedwater
Component :	Turbine Driven Pump
Failure Mode :	Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 41.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9664890	0.9916730	0.9966540	0.9999830	1.0000000	5.1746E+01	4.3452E-01
α_2	1.49E-05	8.33E-03	3.35E-03	3.35E-02	0.00E+00	4.3452E-01	5.1746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9561490	0.9847430	0.9889330	0.9990010	1.0000000	7.1055E+01	1.1009E+00
α_2	3.64E-04	1.16E-02	7.46E-03	3.67E-02	0.00E+00	8.3366E-01	7.1322E+01
α_3	1.29E-07	3.70E-03	7.43E-04	1.76E-02	0.00E+00	2.6722E-01	7.1889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9501060	0.9792710	0.9827280	0.9966150	1.0000000	8.7636E+01	1.8551E+00
α_2	1.13E-03	1.37E-02	1.03E-02	3.80E-02	0.00E+00	1.2281E+00	8.8263E+01
α_3	5.07E-06	4.52E-03	1.67E-03	1.87E-02	0.00E+00	4.0431E-01	8.9087E+01
α_4	1.07E-08	2.49E-03	3.40E-04	1.25E-02	0.00E+00	2.2267E-01	8.9268E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	41.50	41.50	41.50
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.4.2.3 AFW TURBINE DRIVEN PUMP FAIL TO RUN SPAR: AFW-TDP-FR

System :	Auxiliary feedwater
Component :	Turbine Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment) Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 53.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9727360	0.9932300	0.9972820	0.9999870	1.0000000	6.3746E+01	4.3452E-01
α_2	1.21E-05	6.77E-03	2.72E-03	2.73E-02	0.00E+00	4.3452E-01	6.3746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9623600	0.9869190	0.9905240	0.9991440	1.0000000	8.3055E+01	1.1009E+00
α_2	3.11E-04	9.91E-03	6.39E-03	3.15E-02	0.00E+00	8.3366E-01	8.3322E+01
α_3	1.11E-07	3.18E-03	6.36E-04	1.51E-02	0.00E+00	2.6722E-01	8.3889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9559550	0.9817220	0.9847840	0.9970210	1.0000000	9.9636E+01	1.8551E+00
α_2	9.95E-04	1.21E-02	9.08E-03	3.35E-02	0.00E+00	1.2281E+00	1.0026E+02
α_3	4.47E-06	3.98E-03	1.47E-03	1.65E-02	0.00E+00	4.0431E-01	1.0109E+02
α_4	9.43E-09	2.19E-03	2.99E-04	1.10E-02	0.00E+00	2.2267E-01	1.0127E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	53.50	53.50	53.50
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.4.2.4 AFW TURBINE DRIVEN PUMP FAIL TO RUN >1H

System :	Auxiliary feedwater
Component :	Turbine Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment)
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 12.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9232540	0.9808420	0.9921690	0.9999620	1.0000000	2.2246E+01	4.3452E-01
α_2	3.49E-05	1.92E-02	7.83E-03	7.67E-02	0.00E+00	4.3452E-01	2.2246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9262310	0.9741920	0.9811670	0.9982980	1.0000000	4.1555E+01	1.1009E+00
α_2	6.21E-04	1.95E-02	1.27E-02	6.18E-02	0.00E+00	8.3366E-01	4.1822E+01
α_3	2.20E-07	6.26E-03	1.26E-03	2.97E-02	0.00E+00	2.6722E-01	4.2389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9259210	0.9690770	0.9741390	0.9949080	1.0000000	5.8136E+01	1.8551E+00
α_2	1.70E-03	2.05E-02	1.54E-02	5.65E-02	0.00E+00	1.2281E+00	5.8763E+01
α_3	7.59E-06	6.74E-03	2.50E-03	2.78E-02	0.00E+00	4.0431E-01	5.9587E+01
α_4	1.60E-08	3.71E-03	5.09E-04	1.86E-02	0.00E+00	2.2267E-01	5.9768E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	12.00	12.00	12.00
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.4.3 BWR High Pressure Coolant Injection and Reactor Core Isolation Cooling Pumps

1.4.3.1 COMBINED HPCI AND RCIC TDP FAIL TO START

System :	High pressure coolant injection Reactor core isolation
Component :	Turbine Driven Pump
Failure Mode :	Fail to start
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 96.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9649980	0.9866790	0.9895480	0.9985330	0.9896910	1.0625E+02	1.4345E+00
α_2	1.46E-03	1.33E-02	1.04E-02	3.50E-02	1.03E-02	1.4345E+00	1.0625E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	0.9896910
α_2	1.03E-02

MGL Parameter	CCCG=2
1-Beta	9.90E-01
Beta	1.03E-02

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	96.00
N_1	0.0000
N_2	1.0000

1.4.3.2 COMBINED HPCI AND RCIC TDP FTR LESS THAN 1H

System :	High pressure coolant injection Reactor core isolation
Component :	Turbine Driven Pump
Failure Mode :	Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 24.60
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9505160	0.9876840	0.9950160	0.9999760	1.0000000	3.4846E+01	4.3452E-01
α_2	2.22E-05	1.23E-02	4.98E-03	4.95E-02	0.00E+00	4.3452E-01	3.4846E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	1.0000000
α_2	0.00E+00

MGL Parameter	CCCG=2
1-Beta	1.00E+00
Beta	0.00E+00

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	24.60
N_1	0.0000
N_2	0.0000

1.4.3.3 COMBINED HPCI AND RCIC TDP FAIL TO RUN

System :	High pressure coolant injection Reactor core isolation
Component :	Turbine Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment) Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 28.60
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9555320	0.9889380	0.9955360	0.9999780	1.0000000	3.8846E+01	4.3452E-01
α_2	1.99E-05	1.11E-02	4.47E-03	4.45E-02	0.00E+00	4.3452E-01	3.8846E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	1.0000000
α_2	0.00E+00

MGL Parameter	CCCG=2
1-Beta	1.00E+00
Beta	0.00E+00

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	28.60
N_1	0.0000
N_2	0.0000

1.4.3.4 COMBINED HPCI AND RCIC TDP FAIL TO RUN >1H

System :	High pressure coolant injection Reactor core isolation
Component :	Turbine Driven Pump
Failure Mode :	Fail to Run >1 Hour (Standby equipment)
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 4.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8819910	0.9704020	0.9877120	0.9999410	1.0000000	1.4246E+01	4.3452E-01
α_2	5.49E-05	2.96E-02	1.23E-02	1.18E-01	0.00E+00	4.3452E-01	1.4246E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	1.0000000
α_2	0.00E+00

MGL Parameter	CCCG=2
1-Beta	1.00E+00
Beta	0.00E+00

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	4.00
N_1	0.0000
N_2	0.0000

1.5 Motor Operated Valves

1.5.1 Pooled Motor Operated Valve Distributions

1.5.1.1 MOV FAIL TO OPEN/CLOSE ALL SYSTEMS SPAR: MOV-FO

Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 528.60
Total Number of Common-Cause Failure Events: 9

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9748630	0.9890570	0.9906420	0.9978200	0.9907390	1.9733E+02	2.1832E+00
α_2	2.18E-03	1.09E-02	9.36E-03	2.51E-02	9.26E-03	2.1832E+00	1.9733E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9742400	0.9864520	0.9874800	0.9951600	0.9888860	3.0810E+02	4.2313E+00
α_2	3.32E-03	1.09E-02	9.88E-03	2.20E-02	9.13E-03	3.4063E+00	3.0893E+02
α_3	7.98E-05	2.64E-03	1.68E-03	8.46E-03	1.98E-03	8.2502E-01	3.1151E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9724020	0.9836730	0.9844290	0.9923500	0.9865400	4.1498E+02	6.8877E+00
α_2	5.12E-03	1.25E-02	1.18E-02	2.25E-02	1.08E-02	5.2825E+00	4.1659E+02
α_3	1.84E-04	2.68E-03	1.95E-03	7.68E-03	1.95E-03	1.1315E+00	4.2074E+02
α_4	3.30E-06	1.12E-03	4.87E-04	4.39E-03	6.71E-04	4.7367E-01	4.2139E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9737520	0.9834360	0.9840000	0.9911870	0.9874860	5.5623E+02	9.3684E+00
α_2	4.35E-03	1.02E-02	9.59E-03	1.79E-02	7.80E-03	5.7496E+00	5.5985E+02
α_3	1.16E-03	4.71E-03	4.14E-03	1.02E-02	3.63E-03	2.6665E+00	5.6293E+02
α_4	3.03E-05	1.33E-03	8.12E-04	4.42E-03	8.16E-04	7.5479E-01	5.6484E+02
α_5	2.98E-10	3.49E-04	3.50E-05	1.81E-03	2.69E-04	1.9748E-01	5.6540E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9754890	0.9841020	0.9845720	0.9911010	0.9883180	6.6820E+02	1.0794E+01
α_2	3.28E-03	7.95E-03	7.48E-03	1.43E-02	5.67E-03	5.4006E+00	6.7359E+02
α_3	1.65E-03	5.24E-03	4.76E-03	1.05E-02	4.33E-03	3.5562E+00	6.7544E+02
α_4	1.44E-04	1.79E-03	1.34E-03	5.01E-03	1.12E-03	1.2186E+00	6.7778E+02
α_5	2.04E-06	6.97E-04	3.02E-04	2.73E-03	4.50E-04	4.7330E-01	6.7852E+02
α_6	1.10E-12	2.15E-04	8.00E-06	1.19E-03	1.12E-04	1.4574E-01	6.7885E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9764610	0.9841420	0.9845220	0.9905130	0.9894140	8.2676E+02	1.3322E+01
α_2	3.04E-03	7.03E-03	6.64E-03	1.23E-02	4.34E-03	5.9043E+00	8.3418E+02
α_3	1.55E-03	4.62E-03	4.24E-03	9.02E-03	3.47E-03	3.8842E+00	8.3620E+02
α_4	5.31E-04	2.64E-03	2.26E-03	6.05E-03	1.89E-03	2.2161E+00	8.3787E+02
α_5	4.42E-05	1.09E-03	7.27E-04	3.36E-03	6.04E-04	9.1407E-01	8.3917E+02
α_6	1.37E-07	4.08E-04	1.22E-04	1.79E-03	2.41E-04	3.4278E-01	8.3974E+02
α_7	1.98E-25	7.19E-05	7.24E-09	4.03E-04	4.82E-05	6.0371E-02	8.4002E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9778210	0.9848080	0.9851370	0.9906530	0.9902360	9.5285E+02	1.4699E+01
α_2	2.67E-03	6.15E-03	5.81E-03	1.08E-02	3.51E-03	5.9502E+00	9.6160E+02
α_3	1.32E-03	3.97E-03	3.63E-03	7.77E-03	2.84E-03	3.8416E+00	9.6371E+02
α_4	6.51E-04	2.71E-03	2.37E-03	5.91E-03	1.99E-03	2.6201E+00	9.6493E+02
α_5	1.49E-04	1.44E-03	1.12E-03	3.85E-03	9.26E-04	1.3949E+00	9.6615E+02
α_6	7.36E-06	6.48E-04	3.52E-04	2.29E-03	3.51E-04	6.2716E-01	9.6692E+02
α_7	6.80E-10	2.24E-04	2.85E-05	1.13E-03	1.27E-04	2.1677E-01	9.6733E+02
α_8	1.20E-30	5.04E-05	4.01E-10	2.65E-04	2.10E-05	4.8724E-02	9.6750E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9907390	0.9888860	0.9865400	0.9874860	0.9883180	0.9894140	0.9902360
α_2	9.26E-03	9.13E-03	1.08E-02	7.80E-03	5.67E-03	4.34E-03	3.51E-03
α_3		1.98E-03	1.95E-03	3.63E-03	4.33E-03	3.47E-03	2.84E-03
α_4			6.71E-04	8.16E-04	1.12E-03	1.89E-03	1.99E-03
α_5				2.69E-04	4.50E-04	6.04E-04	9.26E-04
α_6					1.12E-04	2.41E-04	3.51E-04
α_7						4.82E-05	1.27E-04
α_8							2.10E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.91E-01	9.89E-01	9.87E-01	9.87E-01	9.88E-01	9.89E-01	9.90E-01
Beta	9.26E-03	1.11E-02	1.35E-02	1.25E-02	1.17E-02	1.06E-02	9.76E-03
Gamma		1.78E-01	1.94E-01	3.76E-01	5.15E-01	5.90E-01	6.40E-01
Delta			2.57E-01	2.30E-01	2.80E-01	4.45E-01	5.46E-01
Epsilon				2.48E-01	3.34E-01	3.21E-01	4.18E-01
Mu					1.99E-01	3.24E-01	3.50E-01
Upsilon						1.67E-01	2.96E-01
Sigma							1.43E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	182.91	274.36	365.81	457.27	548.72	640.17	731.63
N_1	4.1693	4.1814	3.0389	2.8019	2.5394	2.5414	2.4909
N_2	1.7487	2.5726	4.0544	3.6354	3.1614	2.8165	2.6055
N_3		0.5578	0.7272	1.6891	2.4144	2.2530	2.1032
N_4			0.2510	0.3804	0.6264	1.2272	1.4736
N_5				0.1252	0.2511	0.3923	0.6866
N_6					0.0625	0.1565	0.2602
N_7						0.0313	0.0938
N_8							0.0156

1.5.1.2 MOV FAIL TO OPEN ALL SYSTEMS SPAR: MOV-CC

Component :	Motor Operated Valve
Failure Mode :	Fail to open on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 299.80
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9555730	0.9822700	0.9856050	0.9975650	0.9852560	9.1125E+01	1.6448E+00
α_2	2.44E-03	1.77E-02	1.44E-02	4.44E-02	1.47E-02	1.6448E+00	9.1125E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9627610	0.9828000	0.9848600	0.9958120	0.9874880	1.5039E+02	2.6319E+00
α_2	1.87E-03	1.19E-02	9.81E-03	2.89E-02	8.02E-03	1.8146E+00	1.5121E+02
α_3	1.57E-04	5.34E-03	3.40E-03	1.71E-02	4.50E-03	8.1732E-01	1.5220E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9653190	0.9823450	0.9838480	0.9942340	0.9885460	2.0680E+02	3.7167E+00
α_2	1.97E-03	1.02E-02	8.66E-03	2.35E-02	5.61E-03	2.1395E+00	2.0838E+02
α_3	3.42E-04	5.25E-03	3.79E-03	1.51E-02	4.31E-03	1.1045E+00	2.0941E+02
α_4	6.52E-06	2.25E-03	9.73E-04	8.79E-03	1.54E-03	4.7267E-01	2.1004E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9670150	0.9813440	0.9823930	0.9920760	0.9896260	2.9670E+02	5.6406E+00
α_2	2.45E-03	9.40E-03	8.34E-03	2.00E-02	3.59E-03	2.8410E+00	2.9950E+02
α_3	9.90E-04	6.13E-03	5.08E-03	1.49E-02	4.32E-03	1.8529E+00	3.0049E+02
α_4	5.49E-05	2.48E-03	1.50E-03	8.22E-03	1.85E-03	7.4939E-01	3.0159E+02
α_5	5.49E-10	6.53E-04	6.54E-05	3.38E-03	6.17E-04	1.9728E-01	3.0214E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9696850	0.9823280	0.9832020	0.9919840	0.9911300	3.5752E+02	6.4317E+00
α_2	1.52E-03	6.74E-03	5.86E-03	1.50E-02	8.84E-04	2.4537E+00	3.6150E+02
α_3	1.44E-03	6.57E-03	5.70E-03	1.47E-02	5.15E-03	2.3928E+00	3.6156E+02
α_4	1.26E-04	2.66E-03	1.82E-03	8.05E-03	1.54E-03	9.6722E-01	3.6298E+02
α_5	3.74E-06	1.30E-03	5.61E-04	5.08E-03	1.03E-03	4.7220E-01	3.6348E+02
α_6	2.04E-12	4.00E-04	1.49E-05	2.22E-03	2.57E-04	1.4574E-01	3.6381E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9705680	0.9817080	0.9823800	0.9905510	0.9921760	4.6466E+02	8.6578E+00
α_2	2.10E-03	7.03E-03	6.35E-03	1.43E-02	8.55E-04	3.3297E+00	4.6999E+02
α_3	1.11E-03	5.05E-03	4.37E-03	1.13E-02	2.68E-03	2.3895E+00	4.7093E+02
α_4	5.14E-04	3.59E-03	2.92E-03	8.97E-03	2.52E-03	1.7014E+00	4.7162E+02
α_5	5.50E-05	1.76E-03	1.13E-03	5.63E-03	1.10E-03	8.3427E-01	4.7248E+02
α_6	2.41E-07	7.24E-04	2.16E-04	3.17E-03	5.53E-04	3.4258E-01	4.7298E+02
α_7	3.51E-25	1.28E-04	1.29E-08	7.16E-04	1.11E-04	6.0371E-02	4.7326E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9721110	0.9822560	0.9828360	0.9904140	0.9929330	5.3935E+02	9.7430E+00
α_2	2.12E-03	6.63E-03	6.04E-03	1.31E-02	9.11E-04	3.6388E+00	5.4545E+02
α_3	7.97E-04	4.00E-03	3.41E-03	9.20E-03	1.42E-03	2.1955E+00	5.4690E+02
α_4	5.50E-04	3.39E-03	2.81E-03	8.21E-03	2.21E-03	1.8610E+00	5.4723E+02
α_5	1.62E-04	2.15E-03	1.58E-03	6.07E-03	1.46E-03	1.1808E+00	5.4791E+02
α_6	1.04E-05	1.10E-03	5.78E-04	3.94E-03	7.26E-04	6.0136E-01	5.4849E+02
α_7	1.20E-09	3.95E-04	5.03E-05	1.99E-03	2.90E-04	2.1677E-01	5.4888E+02
α_8	2.11E-30	8.87E-05	7.06E-10	4.68E-04	4.83E-05	4.8724E-02	5.4904E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9852560	0.9874880	0.9885460	0.9896260	0.9911300	0.9921760	0.9929330
α_2	1.47E-02	8.02E-03	5.61E-03	3.59E-03	8.84E-04	8.55E-04	9.11E-04
α_3		4.50E-03	4.31E-03	4.32E-03	5.15E-03	2.68E-03	1.42E-03
α_4			1.54E-03	1.85E-03	1.54E-03	2.52E-03	2.21E-03
α_5				6.17E-04	1.03E-03	1.10E-03	1.46E-03
α_6					2.57E-04	5.53E-04	7.26E-04
α_7						1.11E-04	2.90E-04
α_8							4.83E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.85E-01	9.87E-01	9.89E-01	9.90E-01	9.91E-01	9.92E-01	9.93E-01
Beta	1.47E-02	1.25E-02	1.15E-02	1.04E-02	8.87E-03	7.82E-03	7.07E-03
Gamma		3.59E-01	5.10E-01	6.54E-01	9.00E-01	8.91E-01	8.71E-01
Delta			2.63E-01	3.64E-01	3.55E-01	6.15E-01	7.70E-01
Epsilon				2.50E-01	4.55E-01	4.12E-01	5.33E-01
Mu					2.00E-01	3.75E-01	4.21E-01
Upsilon						1.67E-01	3.18E-01
Sigma							1.43E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	79.95	119.92	159.89	199.87	239.84	279.81	319.79
N_1	0.9293	0.9132	0.7766	0.6698	0.7430	0.7972	0.8319
N_2	1.2103	0.9809	0.9114	0.7268	0.2145	0.2419	0.2941
N_3		0.5501	0.7002	0.8755	1.2510	0.7583	0.4571
N_4			0.2500	0.3750	0.3750	0.7125	0.7145
N_5				0.1250	0.2500	0.3125	0.4725
N_6					0.0625	0.1563	0.2344
N_7						0.0313	0.0938
N_8							0.0156

1.5.1.3 MOV FAIL TO CLOSE ALL SYSTEMS SPAR: MOV-OO

Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 208.80
Total Number of Common-Cause Failure Events: 5

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9732160	0.9911050	0.9938630	0.9995680	0.9945450	1.0840E+02	9.7282E-01
α_2	4.29E-04	8.89E-03	6.13E-03	2.68E-02	5.45E-03	9.7282E-01	1.0840E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9673510	0.9848180	0.9865980	0.9962140	0.9891350	1.7518E+02	2.7005E+00
α_2	3.05E-03	1.36E-02	1.19E-02	3.03E-02	1.08E-02	2.4255E+00	1.7546E+02
α_3	7.20E-08	1.55E-03	3.26E-04	7.27E-03	5.30E-05	2.7502E-01	1.7761E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9624660	0.9793370	0.9806360	0.9917670	0.9837600	2.3822E+02	5.0261E+00
α_2	6.57E-03	1.80E-02	1.67E-02	3.38E-02	1.61E-02	4.3711E+00	2.3887E+02
α_3	3.00E-06	1.77E-03	7.01E-04	7.17E-03	1.38E-04	4.3131E-01	2.4281E+02
α_4	4.17E-09	9.20E-04	1.26E-04	4.60E-03	5.12E-06	2.2367E-01	2.4302E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9646390	0.9788050	0.9797280	0.9898100	0.9846670	3.3556E+02	7.2661E+00
α_2	5.82E-03	1.47E-02	1.37E-02	2.67E-02	1.20E-02	5.0228E+00	3.3780E+02
α_3	8.05E-04	5.22E-03	4.30E-03	1.28E-02	3.35E-03	1.7910E+00	3.4104E+02
α_4	8.04E-07	1.11E-03	3.78E-04	4.68E-03	2.22E-05	3.7979E-01	3.4245E+02
α_5	1.95E-21	2.11E-04	1.22E-07	1.22E-03	8.23E-07	7.2477E-02	3.4275E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9662700	0.9790310	0.9798000	0.9891660	0.9850020	4.0347E+02	8.6415E+00
α_2	5.09E-03	1.26E-02	1.18E-02	2.27E-02	1.01E-02	5.1861E+00	4.0693E+02
α_3	1.18E-03	5.59E-03	4.82E-03	1.27E-02	4.00E-03	2.3052E+00	4.0981E+02
α_4	6.61E-05	2.05E-03	1.32E-03	6.51E-03	8.64E-04	8.4362E-01	4.1127E+02
α_5	2.40E-09	5.42E-04	7.41E-05	2.71E-03	3.78E-06	2.2330E-01	4.1189E+02
α_6	3.41E-19	2.02E-04	3.52E-07	1.18E-03	0.00E+00	8.3237E-02	4.1203E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9678370	0.9790030	0.9796020	0.9881160	0.9862250	5.1797E+02	1.1109E+01
α_2	4.54E-03	1.07E-02	1.01E-02	1.89E-02	7.60E-03	5.6624E+00	5.2342E+02
α_3	1.67E-03	5.91E-03	5.30E-03	1.22E-02	4.41E-03	3.1259E+00	5.2595E+02
α_4	3.35E-04	2.84E-03	2.25E-03	7.39E-03	1.52E-03	1.5036E+00	5.2758E+02
α_5	1.08E-05	1.14E-03	6.00E-04	4.09E-03	2.36E-04	6.0157E-01	5.2848E+02
α_6	1.29E-10	3.52E-04	3.01E-05	1.85E-03	5.91E-07	1.8648E-01	5.2889E+02
α_7	0.00E+00	5.49E-05	4.80E-14	2.07E-04	0.00E+00	2.9071E-02	5.2905E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9695570	0.9797250	0.9802430	0.9881160	0.9871680	6.0003E+02	1.2418E+01
α_2	3.91E-03	9.24E-03	8.71E-03	1.64E-02	5.98E-03	5.6562E+00	6.0679E+02
α_3	1.67E-03	5.53E-03	5.00E-03	1.12E-02	4.26E-03	3.3845E+00	6.0906E+02
α_4	5.21E-04	3.11E-03	2.59E-03	7.48E-03	1.97E-03	1.9056E+00	6.1054E+02
α_5	6.27E-05	1.51E-03	1.01E-03	4.64E-03	5.54E-04	9.2243E-01	6.1153E+02
α_6	5.88E-07	6.41E-04	2.28E-04	2.68E-03	6.68E-05	3.9276E-01	6.1205E+02
α_7	2.66E-14	2.01E-04	3.61E-06	1.14E-03	0.00E+00	1.2297E-01	6.1232E+02
α_8	4.97E-43	5.41E-05	7.70E-13	2.28E-04	0.00E+00	3.3124E-02	6.1241E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9945450	0.9891350	0.9837600	0.9846670	0.9850020	0.9862250	0.9871680
α_2	5.45E-03	1.08E-02	1.61E-02	1.20E-02	1.01E-02	7.60E-03	5.98E-03
α_3		5.30E-05	1.38E-04	3.35E-03	4.00E-03	4.41E-03	4.26E-03
α_4			5.12E-06	2.22E-05	8.64E-04	1.52E-03	1.97E-03
α_5				8.23E-07	3.78E-06	2.36E-04	5.54E-04
α_6					0.00E+00	5.91E-07	6.68E-05
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.95E-01	9.89E-01	9.84E-01	9.85E-01	9.85E-01	9.86E-01	9.87E-01
Beta	5.45E-03	1.09E-02	1.62E-02	1.53E-02	1.50E-02	1.38E-02	1.28E-02
Gamma		4.88E-03	8.83E-03	2.20E-01	3.25E-01	4.48E-01	5.34E-01
Delta			3.57E-02	6.84E-03	1.78E-01	2.85E-01	3.78E-01
Epsilon				3.57E-02	4.36E-03	1.35E-01	2.40E-01
Mu					0.00E+00	2.50E-03	1.08E-01
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	94.91	142.36	189.82	237.27	284.73	332.18	379.64
N_1	3.2400	3.2683	2.2623	2.1320	1.7964	1.7442	1.6590
N_2	0.5383	1.5918	3.1430	2.9086	2.9469	2.5746	2.3115
N_3		0.0078	0.0270	0.8136	1.1634	1.4947	1.6461
N_4			0.0010	0.0054	0.2514	0.5147	0.7591
N_5				0.0002	0.0011	0.0798	0.2141
N_6					0.0000	0.0002	0.0258
N_7						0.0000	0.0000
N_8							0.0000

1.5.1.4 MOV SPURIOUS OPERATION ALL SYSTEMS SPAR: MOV-CO

Component : Motor Operated Valve
Failure Mode : Spurious operation open or close
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 29.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8808760	0.9653330	0.9800760	0.9995260	0.9733320	1.8067E+01	6.4882E-01
α_2	4.72E-04	3.47E-02	1.99E-02	1.19E-01	2.67E-02	6.4882E-01	1.8067E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9056120	0.9623000	0.9693210	0.9949480	0.9576580	4.0864E+01	1.6009E+00
α_2	2.62E-03	2.97E-02	2.27E-02	8.09E-02	3.63E-02	1.2623E+00	4.1203E+01
α_3	2.46E-06	7.97E-03	2.37E-03	3.50E-02	6.05E-03	3.3862E-01	4.2126E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9115820	0.9588470	0.9635840	0.9899090	0.9511040	6.0865E+01	2.6123E+00
α_2	4.13E-03	2.74E-02	2.26E-02	6.72E-02	3.32E-02	1.7424E+00	6.1735E+01
α_3	1.19E-04	9.97E-03	5.50E-03	3.50E-02	1.48E-02	6.3291E-01	6.2844E+01
α_4	3.44E-08	3.73E-03	5.88E-04	1.84E-02	9.23E-04	2.3697E-01	6.3240E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9300830	0.9624090	0.9649760	0.9859480	0.9514580	1.1436E+02	4.4669E+00
α_2	5.05E-03	2.14E-02	1.88E-02	4.67E-02	2.24E-02	2.5428E+00	1.1628E+02
α_3	1.25E-03	1.18E-02	9.23E-03	3.13E-02	2.24E-02	1.4060E+00	1.1742E+02
α_4	7.79E-06	3.75E-03	1.54E-03	1.50E-02	3.73E-03	4.4579E-01	1.1838E+02
α_5	5.02E-21	6.08E-04	3.44E-07	3.52E-03	0.00E+00	7.2277E-02	1.1875E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9345180	0.9633350	0.9654660	0.9848790	0.9560440	1.3869E+02	5.2787E+00
α_2	3.87E-03	1.70E-02	1.49E-02	3.77E-02	9.42E-03	2.4535E+00	1.4152E+02
α_3	1.73E-03	1.19E-02	9.73E-03	2.95E-02	2.51E-02	1.7132E+00	1.4226E+02
α_4	1.58E-04	5.60E-03	3.54E-03	1.81E-02	9.42E-03	8.0652E-01	1.4316E+02
α_5	6.45E-09	1.54E-03	2.09E-04	7.73E-03	0.00E+00	2.2220E-01	1.4375E+02
α_6	9.79E-19	5.78E-04	1.01E-06	3.37E-03	0.00E+00	8.3237E-02	1.4389E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9733320	0.9576580	0.9511040	0.9514580	0.9560440
α_2	2.67E-02	3.63E-02	3.32E-02	2.24E-02	9.42E-03
α_3		6.05E-03	1.48E-02	2.24E-02	2.51E-02
α_4			9.23E-04	3.73E-03	9.42E-03
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.73E-01	9.58E-01	9.51E-01	9.51E-01	9.56E-01
Beta	2.67E-02	4.23E-02	4.89E-02	4.85E-02	4.40E-02
Gamma		1.43E-01	3.21E-01	5.38E-01	7.86E-01
Delta			5.89E-02	1.43E-01	2.73E-01
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	7.25	10.88	14.50	18.13	21.75
N_1	0.5714	0.4286	0.2286	0.0714	0.0000
N_2	0.2143	0.4286	0.5143	0.4286	0.2143
N_3		0.0714	0.2286	0.4286	0.5714
N_4			0.0143	0.0714	0.2143
N_5				0.0000	0.0000
N_6					0.0000

1.5.2 PWR Containment Spray Motor Operated Valves

1.5.2.1 CONTAINMENT SPRAY MOV FAIL TO OPEN/CLOSE

System : Containment spray recirculation
Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 28.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9554190	0.9889100	0.9955200	0.9999780	1.0000000	3.8746E+01	4.3452E-01
α_2	1.99E-05	1.11E-02	4.48E-03	4.46E-02	0.00E+00	4.3452E-01	3.8746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9466040	0.9813900	0.9864790	0.9987820	1.0000000	5.8055E+01	1.1009E+00
α_2	4.45E-04	1.41E-02	9.12E-03	4.47E-02	0.00E+00	8.3366E-01	5.8322E+01
α_3	1.58E-07	4.52E-03	9.08E-04	2.14E-02	0.00E+00	2.6722E-01	5.8889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9417210	0.9757480	0.9797670	0.9960250	1.0000000	7.4636E+01	1.8551E+00
α_2	1.32E-03	1.61E-02	1.21E-02	4.44E-02	0.00E+00	1.2281E+00	7.5263E+01
α_3	5.94E-06	5.29E-03	1.96E-03	2.18E-02	0.00E+00	4.0431E-01	7.6087E+01
α_4	1.25E-08	2.91E-03	3.98E-04	1.46E-02	0.00E+00	2.2267E-01	7.6268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9452540	0.9724000	0.9748240	0.9912640	1.0000000	1.2466E+02	3.5382E+00
α_2	3.17E-03	1.65E-02	1.40E-02	3.82E-02	0.00E+00	2.1142E+00	1.2608E+02
α_3	3.72E-04	7.62E-03	5.26E-03	2.29E-02	0.00E+00	9.7738E-01	1.2722E+02
α_4	1.92E-06	2.92E-03	9.83E-04	1.24E-02	0.00E+00	3.7439E-01	1.2782E+02
α_5	4.65E-21	5.64E-04	3.19E-07	3.26E-03	0.00E+00	7.2277E-02	1.2813E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9461020	0.9714220	0.9734990	0.9896500	1.0000000	1.4544E+02	4.2787E+00
α_2	3.07E-03	1.50E-02	1.29E-02	3.40E-02	0.00E+00	2.2392E+00	1.4748E+02
α_3	5.36E-04	7.63E-03	5.58E-03	2.17E-02	0.00E+00	1.1418E+00	1.4858E+02
α_4	3.53E-05	3.96E-03	2.07E-03	1.43E-02	0.00E+00	5.9222E-01	1.4913E+02
α_5	6.20E-09	1.48E-03	2.01E-04	7.44E-03	0.00E+00	2.2220E-01	1.4950E+02
α_6	9.41E-19	5.56E-04	9.72E-07	3.24E-03	0.00E+00	8.3237E-02	1.4964E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	28.50	28.50	28.50	28.50	28.50
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.5.2.2 CONTAINMENT SPRAY MOV-CC

System : Containment spray recirculation
Component : Motor Operated Valve
Failure Mode : Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 18.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9402370	0.9851090	0.9939550	0.9999700	1.0000000	2.8746E+01	4.3452E-01
α_2	2.70E-05	1.49E-02	6.05E-03	5.98E-02	0.00E+00	4.3452E-01	2.8746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9358720	0.9776040	0.9836910	0.9985230	1.0000000	4.8055E+01	1.1009E+00
α_2	5.37E-04	1.70E-02	1.10E-02	5.37E-02	0.00E+00	8.3366E-01	4.8322E+01
α_3	1.90E-07	5.44E-03	1.10E-03	2.58E-02	0.00E+00	2.6722E-01	4.8889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9330730	0.9721000	0.9766930	0.9954150	1.0000000	6.4636E+01	1.8551E+00
α_2	1.53E-03	1.85E-02	1.39E-02	5.10E-02	0.00E+00	1.2281E+00	6.5263E+01
α_3	6.84E-06	6.08E-03	2.25E-03	2.51E-02	0.00E+00	4.0431E-01	6.6087E+01
α_4	1.44E-08	3.35E-03	4.58E-04	1.68E-02	0.00E+00	2.2267E-01	6.6268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9406740	0.9700650	0.9726820	0.9905130	1.0000000	1.1466E+02	3.5382E+00
α_2	3.44E-03	1.79E-02	1.52E-02	4.14E-02	0.00E+00	2.1142E+00	1.1608E+02
α_3	4.04E-04	8.27E-03	5.71E-03	2.49E-02	0.00E+00	9.7738E-01	1.1722E+02
α_4	2.08E-06	3.17E-03	1.07E-03	1.35E-02	0.00E+00	3.7439E-01	1.1782E+02
α_5	5.05E-21	6.11E-04	3.46E-07	3.54E-03	0.00E+00	7.2277E-02	1.1813E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9422810	0.9693770	0.9715880	0.9888990	1.0000000	1.3544E+02	4.2787E+00
α_2	3.29E-03	1.60E-02	1.38E-02	3.64E-02	0.00E+00	2.2392E+00	1.3748E+02
α_3	5.75E-04	8.17E-03	5.98E-03	2.33E-02	0.00E+00	1.1418E+00	1.3858E+02
α_4	3.79E-05	4.24E-03	2.22E-03	1.53E-02	0.00E+00	5.9222E-01	1.3913E+02
α_5	6.65E-09	1.59E-03	2.16E-04	7.97E-03	0.00E+00	2.2220E-01	1.3950E+02
α_6	1.01E-18	5.96E-04	1.04E-06	3.48E-03	0.00E+00	8.3237E-02	1.3964E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	18.50	18.50	18.50	18.50	18.50
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.5.2.3 CONTAINMENT SPRAY MOV-OO

System :	Containment spray recirculation
Component :	Motor Operated Valve
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 10.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9159000	0.9789890	0.9913880	0.9999580	1.0000000	2.0246E+01	4.3452E-01
α_2	3.84E-05	2.10E-02	8.61E-03	8.41E-02	0.00E+00	4.3452E-01	2.0246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9226540	0.9729220	0.9802250	0.9982130	1.0000000	3.9555E+01	1.1009E+00
α_2	6.52E-04	2.05E-02	1.33E-02	6.49E-02	0.00E+00	8.3366E-01	3.9822E+01
α_3	2.31E-07	6.57E-03	1.33E-03	3.12E-02	0.00E+00	2.6722E-01	4.0389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9234090	0.9680110	0.9732370	0.9947340	1.0000000	5.6136E+01	1.8551E+00
α_2	1.76E-03	2.12E-02	1.60E-02	5.84E-02	0.00E+00	1.2281E+00	5.6763E+01
α_3	7.86E-06	6.97E-03	2.59E-03	2.88E-02	0.00E+00	4.0431E-01	5.7587E+01
α_4	1.66E-08	3.84E-03	5.26E-04	1.92E-02	0.00E+00	2.2267E-01	5.7768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9361320	0.9677460	0.9705480	0.9897660	1.0000000	1.0616E+02	3.5382E+00
α_2	3.71E-03	1.93E-02	1.64E-02	4.45E-02	0.00E+00	2.1142E+00	1.0758E+02
α_3	4.35E-04	8.91E-03	6.16E-03	2.68E-02	0.00E+00	9.7738E-01	1.0872E+02
α_4	2.24E-06	3.41E-03	1.15E-03	1.45E-02	0.00E+00	3.7439E-01	1.0932E+02
α_5	5.44E-21	6.59E-04	3.73E-07	3.81E-03	0.00E+00	7.2277E-02	1.0963E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9385840	0.9673930	0.9697400	0.9881690	1.0000000	1.2694E+02	4.2787E+00
α_2	3.51E-03	1.71E-02	1.47E-02	3.88E-02	0.00E+00	2.2392E+00	1.2898E+02
α_3	6.13E-04	8.70E-03	6.37E-03	2.48E-02	0.00E+00	1.1418E+00	1.3008E+02
α_4	4.04E-05	4.51E-03	2.36E-03	1.63E-02	0.00E+00	5.9222E-01	1.3063E+02
α_5	7.08E-09	1.69E-03	2.30E-04	8.48E-03	0.00E+00	2.2220E-01	1.3100E+02
α_6	1.07E-18	6.34E-04	1.11E-06	3.70E-03	0.00E+00	8.3237E-02	1.3114E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	10.00	10.00	10.00	10.00	10.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.5.3 BWR Residual Heat Removal Motor-Operated Valves

1.5.3.1 BWR RHR MOV FAIL TO OPEN/CLOSE

System : Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Plant Type : BWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 127.50
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9599470	0.9844480	0.9876170	0.9981150	0.9875360	9.6079E+01	1.5178E+00
α_2	1.88E-03	1.56E-02	1.24E-02	4.01E-02	1.25E-02	1.5178E+00	9.6079E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9671440	0.9853430	0.9873110	0.9968280	0.9903660	1.5805E+02	2.3509E+00
α_2	1.27E-03	9.87E-03	7.92E-03	2.51E-02	5.78E-03	1.5837E+00	1.5882E+02
α_3	1.15E-04	4.78E-03	2.94E-03	1.57E-02	3.85E-03	7.6722E-01	1.5963E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9692380	0.9847840	0.9862280	0.9954110	0.9913040	2.1714E+02	3.3551E+00
α_2	1.58E-03	8.97E-03	7.54E-03	2.13E-02	4.35E-03	1.9781E+00	2.1852E+02
α_3	1.62E-04	4.10E-03	2.73E-03	1.27E-02	2.90E-03	9.0431E-01	2.1959E+02
α_4	6.23E-06	2.14E-03	9.29E-04	8.39E-03	1.45E-03	4.7267E-01	2.2002E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9701900	0.9834720	0.9844820	0.9932880	0.9922560	3.0970E+02	5.2049E+00
α_2	2.32E-03	8.96E-03	7.95E-03	1.91E-02	3.29E-03	2.8225E+00	3.1208E+02
α_3	4.98E-04	4.56E-03	3.56E-03	1.20E-02	2.13E-03	1.4357E+00	3.1347E+02
α_4	5.27E-05	2.38E-03	1.44E-03	7.89E-03	1.74E-03	7.4939E-01	3.1416E+02
α_5	5.27E-10	6.26E-04	6.28E-05	3.24E-03	5.81E-04	1.9728E-01	3.1471E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9719820	0.9838590	0.9847000	0.9928560	0.9928640	3.7298E+02	6.1190E+00
α_2	2.11E-03	7.81E-03	6.96E-03	1.64E-02	2.80E-03	2.9614E+00	3.7614E+02
α_3	5.15E-04	4.11E-03	3.28E-03	1.06E-02	1.62E-03	1.5585E+00	3.7754E+02
α_4	1.27E-04	2.59E-03	1.78E-03	7.80E-03	1.51E-03	9.8112E-01	3.7812E+02
α_5	3.59E-06	1.25E-03	5.39E-04	4.88E-03	9.69E-04	4.7220E-01	3.7863E+02
α_6	1.96E-12	3.84E-04	1.43E-05	2.13E-03	2.42E-04	1.4574E-01	3.7895E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9721360	0.9827730	0.9834210	0.9911850	0.9932980	4.8256E+02	8.4590E+00
α_2	2.61E-03	7.83E-03	7.17E-03	1.53E-02	2.51E-03	3.8424E+00	4.8718E+02
α_3	7.56E-04	4.15E-03	3.50E-03	9.76E-03	1.35E-03	2.0363E+00	4.8898E+02
α_4	2.64E-04	2.73E-03	2.09E-03	7.38E-03	1.17E-03	1.3408E+00	4.8968E+02
α_5	5.36E-05	1.70E-03	1.09E-03	5.43E-03	1.05E-03	8.3657E-01	4.9018E+02
α_6	2.33E-07	6.98E-04	2.08E-04	3.06E-03	5.20E-04	3.4258E-01	4.9068E+02
α_7	3.38E-25	1.23E-04	1.24E-08	6.91E-04	1.04E-04	6.0371E-02	4.9096E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9733130	0.9830610	0.9836210	0.9908900	0.9936390	5.5969E+02	9.6437E+00
α_2	2.54E-03	7.26E-03	6.69E-03	1.39E-02	2.29E-03	4.1319E+00	5.6520E+02
α_3	7.42E-04	3.79E-03	3.23E-03	8.77E-03	1.23E-03	2.1601E+00	5.6717E+02
α_4	2.85E-04	2.56E-03	2.00E-03	6.72E-03	8.99E-04	1.4551E+00	5.6788E+02
α_5	9.97E-05	1.81E-03	1.27E-03	5.36E-03	9.35E-04	1.0293E+00	5.6830E+02
α_6	1.01E-05	1.06E-03	5.58E-04	3.80E-03	6.84E-04	6.0176E-01	5.6873E+02
α_7	1.16E-09	3.81E-04	4.85E-05	1.92E-03	2.73E-04	2.1677E-01	5.6912E+02
α_8	2.04E-30	8.56E-05	6.81E-10	4.51E-04	4.55E-05	4.8724E-02	5.6928E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9875360	0.9903660	0.9913040	0.9922560	0.9928640	0.9932980	0.9936390
α_2	1.25E-02	5.78E-03	4.35E-03	3.29E-03	2.80E-03	2.51E-03	2.29E-03
α_3		3.85E-03	2.90E-03	2.13E-03	1.62E-03	1.35E-03	1.23E-03
α_4			1.45E-03	1.74E-03	1.51E-03	1.17E-03	8.99E-04
α_5				5.81E-04	9.69E-04	1.05E-03	9.35E-04
α_6					2.42E-04	5.20E-04	6.84E-04
α_7						1.04E-04	2.73E-04
α_8							4.55E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.88E-01	9.90E-01	9.91E-01	9.92E-01	9.93E-01	9.93E-01	9.94E-01
Beta	1.25E-02	9.63E-03	8.70E-03	7.74E-03	7.14E-03	6.70E-03	6.36E-03
Gamma		4.00E-01	5.00E-01	5.75E-01	6.08E-01	6.25E-01	6.39E-01
Delta			3.33E-01	5.22E-01	6.27E-01	6.78E-01	6.98E-01
Epsilon				2.50E-01	4.46E-01	5.88E-01	6.83E-01
Mu					2.00E-01	3.73E-01	5.17E-01
Upsilon						1.67E-01	3.18E-01
Sigma							1.43E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	85.00	127.50	170.00	212.50	255.00	297.50	340.00
N_1	0.8333	1.0000	1.0000	1.0417	1.0417	1.0127	0.9645
N_2	1.0833	0.7500	0.7500	0.7083	0.7222	0.7546	0.7872
N_3		0.5000	0.5000	0.4583	0.4167	0.4051	0.4217
N_4			0.2500	0.3750	0.3889	0.3519	0.3086
N_5				0.1250	0.2500	0.3148	0.3210
N_6					0.0625	0.1563	0.2348
N_7						0.0313	0.0938
N_8							0.0156

1.5.3.2 BWR RHR MOV FAIL TO OPEN

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Motor Operated Valve
Failure Mode :	Fail to open on demand
Plant Type :	BWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 77.20
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9576550	0.9838600	0.9873250	0.9982200	0.9872120	8.7446E+01	1.4345E+00
α_2	1.78E-03	1.61E-02	1.27E-02	4.23E-02	1.28E-02	1.4345E+00	8.7446E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9669310	0.9857520	0.9878850	0.9972880	0.9914380	1.4535E+02	2.1009E+00
α_2	8.70E-04	9.05E-03	6.94E-03	2.44E-02	4.28E-03	1.3337E+00	1.4612E+02
α_3	1.25E-04	5.20E-03	3.20E-03	1.71E-02	4.28E-03	7.6722E-01	1.4668E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9702790	0.9859630	0.9875250	0.9963150	0.9935650	2.0054E+02	2.8551E+00
α_2	8.36E-04	7.27E-03	5.73E-03	1.90E-02	1.61E-03	1.4781E+00	2.0192E+02
α_3	1.76E-04	4.45E-03	2.96E-03	1.38E-02	3.22E-03	9.0431E-01	2.0249E+02
α_4	6.75E-06	2.32E-03	1.01E-03	9.10E-03	1.61E-03	4.7267E-01	2.0292E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9711640	0.9845480	0.9856320	0.9942250	0.9948450	2.8916E+02	4.5383E+00
α_2	1.56E-03	7.62E-03	6.54E-03	1.74E-02	6.44E-04	2.2392E+00	2.9146E+02
α_3	4.53E-04	4.60E-03	3.54E-03	1.24E-02	1.93E-03	1.3524E+00	2.9235E+02
α_4	5.65E-05	2.55E-03	1.55E-03	8.46E-03	1.93E-03	7.4939E-01	2.9295E+02
α_5	5.65E-10	6.72E-04	6.73E-05	3.47E-03	6.44E-04	1.9728E-01	2.9350E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9731710	0.9850810	0.9859830	0.9939010	0.9957010	3.4854E+02	5.2787E+00
α_2	1.37E-03	6.51E-03	5.60E-03	1.47E-02	2.69E-04	2.3017E+00	3.5152E+02
α_3	4.07E-04	3.93E-03	3.05E-03	1.05E-02	1.07E-03	1.3918E+00	3.5243E+02
α_4	1.29E-04	2.73E-03	1.87E-03	8.28E-03	1.61E-03	9.6722E-01	3.5285E+02
α_5	3.85E-06	1.33E-03	5.77E-04	5.23E-03	1.07E-03	4.7220E-01	3.5335E+02
α_6	2.10E-12	4.12E-04	1.54E-05	2.28E-03	2.69E-04	1.4574E-01	3.5367E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9731990	0.9838740	0.9845650	0.9921810	0.9963120	4.5425E+02	7.4452E+00
α_2	1.91E-03	6.76E-03	6.06E-03	1.40E-02	1.15E-04	3.1191E+00	4.5858E+02
α_3	5.94E-04	3.87E-03	3.18E-03	9.50E-03	5.76E-04	1.7875E+00	4.5991E+02
α_4	2.58E-04	2.82E-03	2.14E-03	7.69E-03	1.15E-03	1.3014E+00	4.6039E+02
α_5	5.64E-05	1.81E-03	1.16E-03	5.77E-03	1.15E-03	8.3427E-01	4.6086E+02
α_6	2.48E-07	7.42E-04	2.21E-04	3.25E-03	5.76E-04	3.4258E-01	4.6135E+02
α_7	3.60E-25	1.31E-04	1.32E-08	7.34E-04	1.15E-04	6.0371E-02	4.6163E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9744640	0.9842140	0.9848100	0.9919250	0.9967720	5.2753E+02	8.4611E+00
α_2	1.89E-03	6.27E-03	5.67E-03	1.27E-02	5.04E-05	3.3603E+00	5.3263E+02
α_3	5.43E-04	3.42E-03	2.82E-03	8.33E-03	3.03E-04	1.8322E+00	5.3416E+02
α_4	2.63E-04	2.58E-03	1.99E-03	6.89E-03	7.57E-04	1.3809E+00	5.3461E+02
α_5	1.03E-04	1.90E-03	1.33E-03	5.66E-03	1.01E-03	1.0208E+00	5.3497E+02
α_6	1.07E-05	1.12E-03	5.92E-04	4.03E-03	7.57E-04	6.0136E-01	5.3539E+02
α_7	1.23E-09	4.04E-04	5.15E-05	2.04E-03	3.03E-04	2.1677E-01	5.3577E+02
α_8	2.17E-30	9.09E-05	7.23E-10	4.79E-04	5.04E-05	4.8724E-02	5.3594E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9872120	0.9914380	0.9935650	0.9948450	0.9957010	0.9963120	0.9967720
α_2	1.28E-02	4.28E-03	1.61E-03	6.44E-04	2.69E-04	1.15E-04	5.04E-05
α_3		4.28E-03	3.22E-03	1.93E-03	1.07E-03	5.76E-04	3.03E-04
α_4			1.61E-03	1.93E-03	1.61E-03	1.15E-03	7.57E-04
α_5				6.44E-04	1.07E-03	1.15E-03	1.01E-03
α_6					2.69E-04	5.76E-04	7.57E-04
α_7						1.15E-04	3.03E-04
α_8							5.04E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.87E-01	9.91E-01	9.94E-01	9.95E-01	9.96E-01	9.96E-01	9.97E-01
Beta	1.28E-02	8.56E-03	6.44E-03	5.15E-03	4.30E-03	3.69E-03	3.23E-03
Gamma		5.00E-01	7.50E-01	8.75E-01	9.38E-01	9.69E-01	9.84E-01
Delta			3.33E-01	5.71E-01	7.33E-01	8.39E-01	9.05E-01
Epsilon				2.50E-01	4.55E-01	6.15E-01	7.37E-01
Mu					2.00E-01	3.75E-01	5.24E-01
Upsilon						1.67E-01	3.18E-01
Sigma							1.43E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	77.20	115.80	154.40	193.00	231.60	270.20	308.80
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	1.0000	0.5000	0.2500	0.1250	0.0625	0.0313	0.0156
N_3		0.5000	0.5000	0.3750	0.2500	0.1563	0.0938
N_4			0.2500	0.3750	0.3750	0.3125	0.2344
N_5				0.1250	0.2500	0.3125	0.3125
N_6					0.0625	0.1563	0.2344
N_7						0.0313	0.0938
N_8							0.0156

1.5.3.3 BWR RHR MOV FAIL TO CLOSE

System : Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Plant Type : BWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 47.30
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9446310	0.9853090	0.9929860	0.9999270	0.9966090	3.4729E+01	5.1782E-01
α_2	7.08E-05	1.47E-02	7.02E-03	5.54E-02	3.39E-03	5.1782E-01	3.4729E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9464220	0.9799500	0.9844730	0.9980050	0.9931920	6.6025E+01	1.3509E+00
α_2	1.02E-03	1.61E-02	1.16E-02	4.65E-02	6.81E-03	1.0837E+00	6.6292E+01
α_3	1.38E-07	3.97E-03	7.96E-04	1.88E-02	0.00E+00	2.6722E-01	6.7109E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9457010	0.9756680	0.9788700	0.9946910	0.9897540	9.4436E+01	2.3551E+00
α_2	2.64E-03	1.79E-02	1.47E-02	4.40E-02	1.02E-02	1.7281E+00	9.5063E+01
α_3	4.69E-06	4.18E-03	1.54E-03	1.73E-02	0.00E+00	4.0431E-01	9.6387E+01
α_4	9.89E-09	2.30E-03	3.14E-04	1.15E-02	0.00E+00	2.2267E-01	9.6568E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9503380	0.9738070	0.9757540	0.9906320	0.9890430	1.5633E+02	4.2049E+00
α_2	4.19E-03	1.68E-02	1.48E-02	3.61E-02	9.59E-03	2.6975E+00	1.5784E+02
α_3	3.93E-04	6.61E-03	4.70E-03	1.93E-02	1.37E-03	1.0607E+00	1.5947E+02
α_4	1.53E-06	2.33E-03	7.84E-04	9.91E-03	0.00E+00	3.7439E-01	1.6016E+02
α_5	3.71E-21	4.50E-04	2.54E-07	2.60E-03	0.00E+00	7.2277E-02	1.6046E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9523810	0.9736200	0.9752340	0.9893540	0.9884620	1.8893E+02	5.1190E+00
α_2	3.98E-03	1.49E-02	1.33E-02	3.15E-02	9.06E-03	2.8989E+00	1.9115E+02
α_3	6.25E-04	6.74E-03	5.14E-03	1.83E-02	2.29E-03	1.3085E+00	1.9274E+02
α_4	3.08E-05	3.12E-03	1.66E-03	1.12E-02	1.91E-04	6.0612E-01	1.9344E+02
α_5	4.78E-09	1.15E-03	1.55E-04	5.74E-03	0.00E+00	2.2220E-01	1.9383E+02
α_6	7.26E-19	4.29E-04	7.49E-07	2.50E-03	0.00E+00	8.3237E-02	1.9397E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9551240	0.9729060	0.9740460	0.9868020	0.9880450	2.6784E+02	7.4589E+00
α_2	4.60E-03	1.38E-02	1.27E-02	2.71E-02	8.53E-03	3.8112E+00	2.7149E+02
α_3	1.13E-03	6.83E-03	5.68E-03	1.65E-02	2.93E-03	1.8800E+00	2.7342E+02
α_4	2.06E-04	3.74E-03	2.62E-03	1.11E-02	4.65E-04	1.0283E+00	2.7427E+02
α_5	9.56E-06	1.90E-03	9.04E-04	7.19E-03	2.71E-05	5.2407E-01	2.7477E+02
α_6	2.44E-10	6.77E-04	5.77E-05	3.55E-03	0.00E+00	1.8628E-01	2.7511E+02
α_7	0.00E+00	1.06E-04	9.24E-14	3.97E-04	0.00E+00	2.9071E-02	2.7527E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9570090	0.9732340	0.9742030	0.9861400	0.9877750	3.1429E+02	8.6437E+00
α_2	4.47E-03	1.27E-02	1.18E-02	2.44E-02	7.98E-03	4.1163E+00	3.1882E+02
α_3	1.19E-03	6.40E-03	5.41E-03	1.50E-02	3.39E-03	2.0663E+00	3.2087E+02
α_4	3.05E-04	3.78E-03	2.82E-03	1.05E-02	7.68E-04	1.2208E+00	3.2171E+02
α_5	4.21E-05	2.22E-03	1.31E-03	7.48E-03	8.79E-05	7.1683E-01	3.2222E+02
α_6	6.49E-07	1.14E-03	3.73E-04	4.86E-03	4.13E-06	3.6736E-01	3.2257E+02
α_7	5.04E-14	3.81E-04	6.84E-06	2.17E-03	0.00E+00	1.2297E-01	3.2281E+02
α_8	9.44E-43	1.03E-04	1.46E-12	4.33E-04	0.00E+00	3.3124E-02	3.2290E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9966090	0.9931920	0.9897540	0.9890430	0.9884620	0.9880450	0.9877750
α_2	3.39E-03	6.81E-03	1.02E-02	9.59E-03	9.06E-03	8.53E-03	7.98E-03
α_3		0.00E+00	0.00E+00	1.37E-03	2.29E-03	2.93E-03	3.39E-03
α_4			0.00E+00	0.00E+00	1.91E-04	4.65E-04	7.68E-04
α_5				0.00E+00	0.00E+00	2.71E-05	8.79E-05
α_6					0.00E+00	0.00E+00	4.13E-06
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.97E-01	9.93E-01	9.90E-01	9.89E-01	9.88E-01	9.88E-01	9.88E-01
Beta	3.39E-03	6.81E-03	1.02E-02	1.10E-02	1.15E-02	1.20E-02	1.22E-02
Gamma		0.00E+00	0.00E+00	1.25E-01	2.15E-01	2.87E-01	3.48E-01
Delta			0.00E+00	0.00E+00	7.70E-02	1.44E-01	2.02E-01
Epsilon				0.00E+00	0.00E+00	5.52E-02	1.07E-01
Mu					0.00E+00	0.00E+00	4.49E-02
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	23.65	35.47	47.30	59.13	70.95	82.78	94.60
N_1	0.8333	1.0000	1.0000	1.0417	1.0417	1.0127	0.9645
N_2	0.0833	0.2500	0.5000	0.5833	0.6597	0.7234	0.7716
N_3		0.0000	0.0000	0.0833	0.1667	0.2488	0.3279
N_4			0.0000	0.0000	0.0139	0.0394	0.0743
N_5				0.0000	0.0000	0.0023	0.0085
N_6					0.0000	0.0000	0.0004
N_7						0.0000	0.0000
N_8							0.0000

1.5.4 BWR Isolation Condenser Motor-Operated Valves

1.5.4.1 ISO CONDENSER MOV FAIL TO OPEN/CLOSE

System : Isolation condenser
Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 8.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9074740	0.9768630	0.9904870	0.9999540	1.0000000	1.8346E+01	4.3452E-01
α_2	4.25E-05	2.31E-02	9.51E-03	9.25E-02	0.00E+00	4.3452E-01	1.8346E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9189190	0.9715950	0.9792390	0.9981230	1.0000000	3.7655E+01	1.1009E+00
α_2	6.85E-04	2.15E-02	1.40E-02	6.80E-02	0.00E+00	8.3366E-01	3.7922E+01
α_3	2.42E-07	6.89E-03	1.39E-03	3.27E-02	0.00E+00	2.6722E-01	3.8489E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9208540	0.9669270	0.9723140	0.9945510	1.0000000	5.4236E+01	1.8551E+00
α_2	1.82E-03	2.19E-02	1.65E-02	6.04E-02	0.00E+00	1.2281E+00	5.4863E+01
α_3	8.13E-06	7.21E-03	2.68E-03	2.98E-02	0.00E+00	4.0431E-01	5.5687E+01
α_4	1.72E-08	3.97E-03	5.44E-04	1.99E-02	0.00E+00	2.2267E-01	5.5868E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9350200	0.9671770	0.9700260	0.9895830	1.0000000	1.0426E+02	3.5382E+00
α_2	3.78E-03	1.96E-02	1.67E-02	4.53E-02	0.00E+00	2.1142E+00	1.0568E+02
α_3	4.43E-04	9.07E-03	6.27E-03	2.73E-02	0.00E+00	9.7738E-01	1.0682E+02
α_4	2.28E-06	3.47E-03	1.17E-03	1.47E-02	0.00E+00	3.7439E-01	1.0742E+02
α_5	5.54E-21	6.70E-04	3.79E-07	3.88E-03	0.00E+00	7.2277E-02	1.0773E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9376920	0.9669140	0.9692930	0.9879930	1.0000000	1.2504E+02	4.2787E+00
α_2	3.56E-03	1.73E-02	1.49E-02	3.94E-02	0.00E+00	2.2392E+00	1.2708E+02
α_3	6.22E-04	8.83E-03	6.46E-03	2.51E-02	0.00E+00	1.1418E+00	1.2818E+02
α_4	4.10E-05	4.58E-03	2.40E-03	1.65E-02	0.00E+00	5.9222E-01	1.2873E+02
α_5	7.18E-09	1.72E-03	2.33E-04	8.61E-03	0.00E+00	2.2220E-01	1.2910E+02
α_6	1.09E-18	6.44E-04	1.13E-06	3.76E-03	0.00E+00	8.3237E-02	1.2924E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	8.10	8.10	8.10	8.10	8.10
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.5.4.2 ISO CONDENSER MOV FAIL TO OPEN

System :	Isolation condenser
Component :	Motor Operated Valve
Failure Mode :	Fail to open on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 6.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8965820	0.9741060	0.9893090	0.9999480	1.0000000	1.6346E+01	4.3452E-01
α_2	4.78E-05	2.59E-02	1.07E-02	1.03E-01	0.00E+00	4.3452E-01	1.6346E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9145760	0.9700490	0.9780880	0.9980190	1.0000000	3.5655E+01	1.1009E+00
α_2	7.23E-04	2.27E-02	1.48E-02	7.17E-02	0.00E+00	8.3366E-01	3.5922E+01
α_3	2.56E-07	7.27E-03	1.47E-03	3.45E-02	0.00E+00	2.6722E-01	3.6489E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9179750	0.9657050	0.9712790	0.9943440	1.0000000	5.2236E+01	1.8551E+00
α_2	1.88E-03	2.27E-02	1.71E-02	6.26E-02	0.00E+00	1.2281E+00	5.2863E+01
α_3	8.43E-06	7.47E-03	2.78E-03	3.09E-02	0.00E+00	4.0431E-01	5.3687E+01
α_4	1.78E-08	4.12E-03	5.65E-04	2.06E-02	0.00E+00	2.2267E-01	5.3868E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9338070	0.9665570	0.9694560	0.9893830	1.0000000	1.0226E+02	3.5382E+00
α_2	3.85E-03	2.00E-02	1.70E-02	4.62E-02	0.00E+00	2.1142E+00	1.0368E+02
α_3	4.51E-04	9.24E-03	6.38E-03	2.78E-02	0.00E+00	9.7738E-01	1.0482E+02
α_4	2.33E-06	3.54E-03	1.19E-03	1.50E-02	0.00E+00	3.7439E-01	1.0542E+02
α_5	5.64E-21	6.83E-04	3.86E-07	3.96E-03	0.00E+00	7.2277E-02	1.0573E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9367240	0.9663940	0.9688130	0.9878010	1.0000000	1.2304E+02	4.2787E+00
α_2	3.62E-03	1.76E-02	1.51E-02	4.00E-02	0.00E+00	2.2392E+00	1.2508E+02
α_3	6.32E-04	8.97E-03	6.56E-03	2.55E-02	0.00E+00	1.1418E+00	1.2618E+02
α_4	4.16E-05	4.65E-03	2.44E-03	1.68E-02	0.00E+00	5.9222E-01	1.2673E+02
α_5	7.30E-09	1.75E-03	2.37E-04	8.74E-03	0.00E+00	2.2220E-01	1.2710E+02
α_6	1.11E-18	6.54E-04	1.14E-06	3.82E-03	0.00E+00	8.3237E-02	1.2724E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	6.10	6.10	6.10	6.10	6.10
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.5.4.3 ISO CONDENSER MOV FAIL TO CLOSE

System :	Isolation condenser
Component :	Motor Operated Valve
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 2.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8636860	0.9657330	0.9856730	0.9999380	1.0000000	1.2246E+01	4.3452E-01
α_2	6.41E-05	3.43E-02	1.43E-02	1.36E-01	0.00E+00	4.3452E-01	1.2246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9040420	0.9662880	0.9752810	0.9977560	1.0000000	3.1555E+01	1.1009E+00
α_2	8.16E-04	2.55E-02	1.67E-02	8.05E-02	0.00E+00	8.3366E-01	3.1822E+01
α_3	2.88E-07	8.18E-03	1.66E-03	3.88E-02	0.00E+00	2.6722E-01	3.2389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9113590	0.9628920	0.9688970	0.9938680	1.0000000	4.8136E+01	1.8551E+00
α_2	2.04E-03	2.46E-02	1.86E-02	6.77E-02	0.00E+00	1.2281E+00	4.8763E+01
α_3	9.14E-06	8.09E-03	3.01E-03	3.34E-02	0.00E+00	4.0431E-01	4.9587E+01
α_4	1.93E-08	4.45E-03	6.12E-04	2.23E-02	0.00E+00	2.2267E-01	4.9768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9311740	0.9652090	0.9682200	0.9889480	1.0000000	9.8161E+01	3.5382E+00
α_2	4.01E-03	2.08E-02	1.77E-02	4.80E-02	0.00E+00	2.1142E+00	9.9585E+01
α_3	4.70E-04	9.61E-03	6.64E-03	2.89E-02	0.00E+00	9.7738E-01	1.0072E+02
α_4	2.42E-06	3.68E-03	1.24E-03	1.56E-02	0.00E+00	3.7439E-01	1.0132E+02
α_5	5.87E-21	7.11E-04	4.02E-07	4.12E-03	0.00E+00	7.2277E-02	1.0163E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9346440	0.9652760	0.9677640	0.9873890	1.0000000	1.1894E+02	4.2787E+00
α_2	3.74E-03	1.82E-02	1.56E-02	4.13E-02	0.00E+00	2.2392E+00	1.2098E+02
α_3	6.53E-04	9.27E-03	6.78E-03	2.64E-02	0.00E+00	1.1418E+00	1.2208E+02
α_4	4.30E-05	4.81E-03	2.52E-03	1.73E-02	0.00E+00	5.9222E-01	1.2263E+02
α_5	7.54E-09	1.80E-03	2.45E-04	9.04E-03	0.00E+00	2.2220E-01	1.2300E+02
α_6	1.14E-18	6.76E-04	1.18E-06	3.94E-03	0.00E+00	8.3237E-02	1.2314E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	2.00	2.00	2.00	2.00	2.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.5.5 PWR Auxiliary Feedwater Motor-Operated Valves

1.5.5.1 AFW MOV FAIL TO OPEN/CLOSE SPAR: AFW-MOV-FO

System : Auxiliary feedwater
Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 63.80
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9267100	0.9764520	0.9843710	0.9991510	0.9834450	3.5986E+01	8.6782E-01
α_2	8.46E-04	2.35E-02	1.56E-02	7.33E-02	1.66E-02	8.6782E-01	3.5986E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9256900	0.9668050	0.9711930	0.9928990	0.9689600	6.7015E+01	2.3009E+00
α_2	5.13E-03	2.86E-02	2.42E-02	6.72E-02	2.97E-02	1.9837E+00	6.7332E+01
α_3	8.13E-07	4.58E-03	1.23E-03	2.05E-02	1.29E-03	3.1722E-01	6.8999E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9218600	0.9589580	0.9620210	0.9855770	0.9567040	9.4749E+01	4.0551E+00
α_2	9.64E-03	3.27E-02	2.96E-02	6.63E-02	3.94E-02	3.2281E+00	9.5576E+01
α_3	5.98E-05	6.12E-03	3.26E-03	2.19E-02	3.94E-03	6.0431E-01	9.8200E+01
α_4	9.69E-09	2.25E-03	3.08E-04	1.13E-02	0.00E+00	2.2267E-01	9.8581E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9343700	0.9618270	0.9637100	0.9828560	0.9575720	1.5634E+02	6.2049E+00
α_2	8.31E-03	2.43E-02	2.24E-02	4.68E-02	2.92E-02	3.9475E+00	1.5860E+02
α_3	1.75E-03	1.11E-02	9.21E-03	2.71E-02	1.33E-02	1.8107E+00	1.6073E+02
α_4	1.51E-06	2.30E-03	7.74E-04	9.78E-03	0.00E+00	3.7439E-01	1.6217E+02
α_5	3.67E-21	4.45E-04	2.51E-07	2.57E-03	0.00E+00	7.2277E-02	1.6247E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9383570	0.9628720	0.9644390	0.9820460	0.9599050	1.8876E+02	7.2786E+00
α_2	6.10E-03	1.88E-02	1.72E-02	3.70E-02	1.93E-02	3.6836E+00	1.9235E+02
α_3	3.15E-03	1.32E-02	1.16E-02	2.88E-02	1.93E-02	2.5862E+00	1.9345E+02
α_4	6.37E-05	3.59E-03	2.10E-03	1.22E-02	1.48E-03	7.0332E-01	1.9534E+02
α_5	4.73E-09	1.13E-03	1.53E-04	5.68E-03	0.00E+00	2.2220E-01	1.9582E+02
α_6	7.18E-19	4.25E-04	7.42E-07	2.48E-03	0.00E+00	8.3237E-02	1.9596E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9463480	0.9659380	0.9670550	0.9817260	0.9654350	2.6784E+02	9.4449E+00
α_2	5.35E-03	1.51E-02	1.39E-02	2.88E-02	1.26E-02	4.1841E+00	2.7310E+02
α_3	2.74E-03	1.04E-02	9.22E-03	2.19E-02	1.43E-02	2.8756E+00	2.7441E+02
α_4	7.67E-04	5.81E-03	4.67E-03	1.47E-02	7.17E-03	1.6111E+00	2.7567E+02
α_5	1.38E-05	2.02E-03	1.01E-03	7.43E-03	4.26E-04	5.5877E-01	2.7673E+02
α_6	2.42E-10	6.72E-04	5.73E-05	3.53E-03	0.00E+00	1.8628E-01	2.7710E+02
α_7	0.00E+00	1.05E-04	9.17E-14	3.94E-04	0.00E+00	2.9071E-02	2.7726E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9502580	0.9678080	0.9687650	0.9820990	0.9696230	3.1449E+02	1.0461E+01
α_2	4.56E-03	1.29E-02	1.19E-02	2.45E-02	8.48E-03	4.1822E+00	3.2077E+02
α_3	2.24E-03	8.66E-03	7.67E-03	1.84E-02	1.09E-02	2.8135E+00	3.2214E+02
α_4	1.05E-03	6.04E-03	5.06E-03	1.44E-02	8.27E-03	1.9628E+00	3.2299E+02
α_5	1.41E-04	2.98E-03	2.04E-03	9.01E-03	2.62E-03	9.6713E-01	3.2398E+02
α_6	8.38E-07	1.17E-03	3.98E-04	4.94E-03	1.25E-04	3.7926E-01	3.2457E+02
α_7	5.01E-14	3.78E-04	6.80E-06	2.15E-03	0.00E+00	1.2297E-01	3.2483E+02
α_8	9.37E-43	1.02E-04	1.45E-12	4.31E-04	0.00E+00	3.3124E-02	3.2492E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9834450	0.9689600	0.9567040	0.9575720	0.9599050	0.9654350	0.9696230
α_2	1.66E-02	2.97E-02	3.94E-02	2.92E-02	1.93E-02	1.26E-02	8.48E-03
α_3		1.29E-03	3.94E-03	1.33E-02	1.93E-02	1.43E-02	1.09E-02
α_4			0.00E+00	0.00E+00	1.48E-03	7.17E-03	8.27E-03
α_5				0.00E+00	0.00E+00	4.26E-04	2.62E-03
α_6					0.00E+00	0.00E+00	1.25E-04
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.83E-01	9.69E-01	9.57E-01	9.58E-01	9.60E-01	9.65E-01	9.70E-01
Beta	1.66E-02	3.10E-02	4.33E-02	4.24E-02	4.01E-02	3.46E-02	3.04E-02
Gamma		4.17E-02	9.09E-02	3.12E-01	5.19E-01	6.35E-01	7.21E-01
Delta			0.00E+00	0.00E+00	7.14E-02	3.46E-01	5.03E-01
Epsilon				0.00E+00	0.00E+00	5.61E-02	2.49E-01
Mu					0.00E+00	0.00E+00	4.54E-02
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	23.94	35.91	47.88	59.85	71.82	83.79	95.76
N_1	1.8000	1.5500	0.7333	0.3333	0.0000	0.0000	0.0000
N_2	0.4333	1.1500	2.0000	1.8333	1.4444	1.0963	0.8375
N_3		0.0500	0.2000	0.8333	1.4444	1.2444	1.0751
N_4			0.0000	0.0000	0.1111	0.6222	0.8163
N_5				0.0000	0.0000	0.0370	0.2588
N_6					0.0000	0.0000	0.0123
N_7						0.0000	0.0000
N_8							0.0000

1.5.5.2 AFW MOV FAIL TO OPEN SPAR: AFW-MOV-CC

System : Auxiliary feedwater
Component : Motor Operated Valve
Failure Mode : Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 34.20
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9035630	0.9722680	0.9843960	0.9996560	0.9836070	2.2246E+01	6.3452E-01
α_2	3.42E-04	2.77E-02	1.56E-02	9.64E-02	1.64E-02	6.3452E-01	2.2246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9175080	0.9671310	0.9733050	0.9956120	0.9722990	4.7105E+01	1.6009E+00
α_2	2.39E-03	2.64E-02	2.02E-02	7.14E-02	2.49E-02	1.2837E+00	4.7422E+01
α_3	1.16E-06	6.51E-03	1.76E-03	2.92E-02	2.77E-03	3.1722E-01	4.8389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9207730	0.9630170	0.9672430	0.9908100	0.9663870	6.9136E+01	2.6551E+00
α_2	4.09E-03	2.55E-02	2.12E-02	6.14E-02	2.52E-02	1.8281E+00	6.9963E+01
α_3	8.26E-05	8.42E-03	4.49E-03	3.01E-02	8.40E-03	6.0431E-01	7.1187E+01
α_4	1.34E-08	3.10E-03	4.24E-04	1.55E-02	0.00E+00	2.2267E-01	7.1568E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9348730	0.9648740	0.9672520	0.9867520	0.9661020	1.2466E+02	4.5383E+00
α_2	4.91E-03	2.02E-02	1.78E-02	4.38E-02	1.69E-02	2.6142E+00	1.2658E+02
α_3	1.32E-03	1.14E-02	9.03E-03	2.98E-02	1.69E-02	1.4774E+00	1.2772E+02
α_4	1.90E-06	2.90E-03	9.75E-04	1.23E-02	0.00E+00	3.7439E-01	1.2882E+02
α_5	4.62E-21	5.59E-04	3.16E-07	3.24E-03	0.00E+00	7.2277E-02	1.2913E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9396790	0.9662530	0.9682260	0.9861000	0.9715910	1.5114E+02	5.2787E+00
α_2	2.94E-03	1.43E-02	1.23E-02	3.26E-02	0.00E+00	2.2392E+00	1.5418E+02
α_3	2.67E-03	1.37E-02	1.17E-02	3.16E-02	2.84E-02	2.1418E+00	1.5428E+02
α_4	3.38E-05	3.79E-03	1.98E-03	1.37E-02	0.00E+00	5.9222E-01	1.5583E+02
α_5	5.93E-09	1.42E-03	1.92E-04	7.12E-03	0.00E+00	2.2220E-01	1.5620E+02
α_6	9.01E-19	5.32E-04	9.30E-07	3.10E-03	0.00E+00	8.3237E-02	1.5634E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9467660	0.9678250	0.9691680	0.9843130	0.9755500	2.2395E+02	7.4450E+00
α_2	3.76E-03	1.33E-02	1.20E-02	2.76E-02	0.00E+00	3.0878E+00	2.2831E+02
α_3	1.96E-03	9.64E-03	8.27E-03	2.20E-02	1.47E-02	2.2312E+00	2.2916E+02
α_4	6.20E-04	6.00E-03	4.65E-03	1.60E-02	9.78E-03	1.3889E+00	2.3001E+02
α_5	1.11E-05	2.25E-03	1.07E-03	8.52E-03	0.00E+00	5.2177E-01	2.3087E+02
α_6	2.90E-10	8.05E-04	6.87E-05	4.23E-03	0.00E+00	1.8628E-01	2.3121E+02
α_7	0.00E+00	1.26E-04	1.10E-13	4.73E-04	0.00E+00	2.9071E-02	2.3137E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9500150	0.9689840	0.9701220	0.9840590	0.9785410	2.6433E+02	8.4610E+00
α_2	3.69E-03	1.23E-02	1.11E-02	2.48E-02	0.00E+00	3.3447E+00	2.6945E+02
α_3	1.46E-03	7.69E-03	6.53E-03	1.79E-02	7.73E-03	2.0984E+00	2.7069E+02
α_4	7.99E-04	5.96E-03	4.81E-03	1.51E-02	1.03E-02	1.6265E+00	2.7116E+02
α_5	1.12E-04	3.18E-03	2.08E-03	1.00E-02	3.43E-03	8.6833E-01	2.7192E+02
α_6	7.61E-07	1.35E-03	4.40E-04	5.75E-03	0.00E+00	3.6696E-01	2.7242E+02
α_7	5.97E-14	4.51E-04	8.10E-06	2.57E-03	0.00E+00	1.2297E-01	2.7267E+02
α_8	1.12E-42	1.21E-04	1.73E-12	5.13E-04	0.00E+00	3.3124E-02	2.7276E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9836070	0.9722990	0.9663870	0.9661020	0.9715910	0.9755500	0.9785410
α_2	1.64E-02	2.49E-02	2.52E-02	1.69E-02	0.00E+00	0.00E+00	0.00E+00
α_3		2.77E-03	8.40E-03	1.69E-02	2.84E-02	1.47E-02	7.73E-03
α_4			0.00E+00	0.00E+00	0.00E+00	9.78E-03	1.03E-02
α_5				0.00E+00	0.00E+00	0.00E+00	3.43E-03
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.84E-01	9.72E-01	9.66E-01	9.66E-01	9.72E-01	9.76E-01	9.79E-01
Beta	1.64E-02	2.77E-02	3.36E-02	3.39E-02	2.84E-02	2.44E-02	2.15E-02
Gamma		1.00E-01	2.50E-01	5.00E-01	1.00E+00	1.00E+00	1.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	4.00E-01	6.40E-01
Epsilon				0.00E+00	0.00E+00	0.00E+00	2.50E-01
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	11.40	17.10	22.80	28.50	34.20	39.90	45.60
N_1	0.6000	0.4500	0.2000	0.0000	0.0000	0.0000	0.0000
N_2	0.2000	0.4500	0.6000	0.5000	0.0000	0.0000	0.0000
N_3		0.0500	0.2000	0.5000	1.0000	0.6000	0.3600
N_4			0.0000	0.0000	0.0000	0.4000	0.4800
N_5				0.0000	0.0000	0.0000	0.1600
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.5.5.3 AFW MOV FAIL TO CLOSE SPAR: AFW-MOV-OO

System :	Auxiliary feedwater
Component :	Motor Operated Valve
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 28.60
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9032530	0.9716470	0.9835190	0.9995700	0.9818770	2.2886E+01	6.6782E-01
α_2	4.28E-04	2.84E-02	1.65E-02	9.67E-02	1.81E-02	6.6782E-01	2.2886E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9124430	0.9637030	0.9697520	0.9942360	0.9630800	4.7815E+01	1.8009E+00
α_2	3.85E-03	3.09E-02	2.48E-02	7.88E-02	3.69E-02	1.5337E+00	4.8082E+01
α_3	1.89E-07	5.39E-03	1.09E-03	2.55E-02	0.00E+00	2.6722E-01	4.9349E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9098670	0.9552900	0.9594080	0.9866290	0.9435790	6.9549E+01	3.2551E+00
α_2	8.88E-03	3.61E-02	3.19E-02	7.76E-02	5.64E-02	2.6281E+00	7.0176E+01
α_3	6.24E-06	5.55E-03	2.06E-03	2.29E-02	0.00E+00	4.0431E-01	7.2400E+01
α_4	1.32E-08	3.06E-03	4.18E-04	1.53E-02	0.00E+00	2.2267E-01	7.2581E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9284930	0.9600530	0.9623860	0.9836280	0.9455360	1.2509E+02	5.2049E+00
α_2	8.20E-03	2.65E-02	2.41E-02	5.29E-02	4.36E-02	3.4475E+00	1.2685E+02
α_3	9.37E-04	1.01E-02	7.69E-03	2.73E-02	1.09E-02	1.3107E+00	1.2898E+02
α_4	1.89E-06	2.87E-03	9.67E-04	1.22E-02	0.00E+00	3.7439E-01	1.2992E+02
α_5	4.58E-21	5.55E-04	3.13E-07	3.21E-03	0.00E+00	7.2277E-02	1.3022E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9316960	0.9601460	0.9620820	0.9819870	0.9449370	1.5126E+02	6.2786E+00
α_2	7.61E-03	2.34E-02	2.14E-02	4.59E-02	3.98E-02	3.6836E+00	1.5385E+02
α_3	1.30E-03	1.01E-02	8.08E-03	2.56E-02	1.22E-02	1.5862E+00	1.5595E+02
α_4	7.93E-05	4.46E-03	2.62E-03	1.51E-02	3.06E-03	7.0332E-01	1.5684E+02
α_5	5.89E-09	1.41E-03	1.91E-04	7.07E-03	0.00E+00	2.2220E-01	1.5732E+02
α_6	8.95E-19	5.28E-04	9.24E-07	3.08E-03	0.00E+00	8.3237E-02	1.5746E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9415360	0.9636830	0.9650080	0.9813180	0.9524290	2.2409E+02	8.4449E+00
α_2	6.39E-03	1.80E-02	1.66E-02	3.43E-02	2.61E-02	4.1841E+00	2.2835E+02
α_3	2.04E-03	9.79E-03	8.42E-03	2.22E-02	1.53E-02	2.2756E+00	2.3026E+02
α_4	4.14E-04	5.21E-03	3.88E-03	1.46E-02	5.29E-03	1.2111E+00	2.3132E+02
α_5	1.65E-05	2.40E-03	1.20E-03	8.86E-03	8.80E-04	5.5877E-01	2.3198E+02
α_6	2.89E-10	8.01E-04	6.84E-05	4.20E-03	0.00E+00	1.8628E-01	2.3235E+02
α_7	0.00E+00	1.25E-04	1.09E-13	4.70E-04	0.00E+00	2.9071E-02	2.3251E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9456270	0.9654650	0.9665910	0.9814580	0.9581240	2.6449E+02	9.4610E+00
α_2	5.41E-03	1.53E-02	1.41E-02	2.91E-02	1.75E-02	4.1822E+00	2.6977E+02
α_3	2.02E-03	8.96E-03	7.79E-03	1.99E-02	1.50E-02	2.4535E+00	2.7150E+02
α_4	6.25E-04	5.41E-03	4.27E-03	1.41E-02	7.04E-03	1.4828E+00	2.7247E+02
α_5	8.32E-05	2.95E-03	1.86E-03	9.51E-03	2.07E-03	8.0713E-01	2.7314E+02
α_6	9.95E-07	1.38E-03	4.72E-04	5.86E-03	2.58E-04	3.7926E-01	2.7357E+02
α_7	5.94E-14	4.49E-04	8.07E-06	2.56E-03	0.00E+00	1.2297E-01	2.7383E+02
α_8	1.11E-42	1.21E-04	1.72E-12	5.11E-04	0.00E+00	3.3124E-02	2.7392E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9818770	0.9630800	0.9435790	0.9455360	0.9449370	0.9524290	0.9581240
α_2	1.81E-02	3.69E-02	5.64E-02	4.36E-02	3.98E-02	2.61E-02	1.75E-02
α_3		0.00E+00	0.00E+00	1.09E-02	1.22E-02	1.53E-02	1.50E-02
α_4			0.00E+00	0.00E+00	3.06E-03	5.29E-03	7.04E-03
α_5				0.00E+00	0.00E+00	8.80E-04	2.07E-03
α_6					0.00E+00	0.00E+00	2.58E-04
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.82E-01	9.63E-01	9.44E-01	9.46E-01	9.45E-01	9.52E-01	9.58E-01
Beta	1.81E-02	3.69E-02	5.64E-02	5.45E-02	5.51E-02	4.76E-02	4.19E-02
Gamma		0.00E+00	0.00E+00	2.00E-01	2.78E-01	4.52E-01	5.81E-01
Delta			0.00E+00	0.00E+00	2.00E-01	2.87E-01	3.85E-01
Epsilon				0.00E+00	0.00E+00	1.43E-01	2.48E-01
Mu					0.00E+00	0.00E+00	1.11E-01
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	11.44	17.16	22.88	28.60	34.32	40.04	45.76
N_1	1.2000	1.1000	0.5333	0.3333	0.0000	0.0000	0.0000
N_2	0.2333	0.7000	1.4000	1.3333	1.4444	1.0963	0.8375
N_3		0.0000	0.0000	0.3333	0.4444	0.6444	0.7151
N_4			0.0000	0.0000	0.1111	0.2222	0.3363
N_5				0.0000	0.0000	0.0370	0.0988
N_6					0.0000	0.0000	0.0123
N_7						0.0000	0.0000
N_8							0.0000

1.5.6 PWR High Pressure Safety Injection Motor-Operated Valves

1.5.6.1 HIGH PRESSURE INJECTION MOV FAIL TO OPEN/CLOSE

System : Chemical and volume control
High pressure injection
Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 64.60
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9767480	0.9942280	0.9976910	0.9999910	1.0000000	7.4846E+01	4.3452E-01
α_2	1.03E-05	5.77E-03	2.31E-03	2.33E-02	0.00E+00	4.3452E-01	7.4846E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9667240	0.9884430	0.9916400	0.9992440	1.0000000	9.4155E+01	1.1009E+00
α_2	2.75E-04	8.75E-03	5.64E-03	2.79E-02	0.00E+00	8.3366E-01	9.4422E+01
α_3	9.76E-08	2.81E-03	5.62E-04	1.33E-02	0.00E+00	2.6722E-01	9.4989E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9602660	0.9835240	0.9862930	0.9973180	1.0000000	1.1074E+02	1.8551E+00
α_2	8.96E-04	1.09E-02	8.18E-03	3.02E-02	0.00E+00	1.2281E+00	1.1137E+02
α_3	4.02E-06	3.59E-03	1.33E-03	1.48E-02	0.00E+00	4.0431E-01	1.1219E+02
α_4	8.50E-09	1.98E-03	2.70E-04	9.90E-03	0.00E+00	2.2267E-01	1.1237E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9571920	0.9784640	0.9803750	0.9932020	1.0000000	1.6076E+02	3.5382E+00
α_2	2.47E-03	1.29E-02	1.09E-02	2.98E-02	0.00E+00	2.1142E+00	1.6218E+02
α_3	2.90E-04	5.95E-03	4.10E-03	1.79E-02	0.00E+00	9.7738E-01	1.6332E+02
α_4	1.50E-06	2.28E-03	7.66E-04	9.68E-03	0.00E+00	3.7439E-01	1.6392E+02
α_5	3.63E-21	4.40E-04	2.48E-07	2.54E-03	0.00E+00	7.2277E-02	1.6423E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9564850	0.9769740	0.9786630	0.9916860	1.0000000	1.8154E+02	4.2787E+00
α_2	2.47E-03	1.21E-02	1.03E-02	2.75E-02	0.00E+00	2.2392E+00	1.8358E+02
α_3	4.32E-04	6.14E-03	4.49E-03	1.75E-02	0.00E+00	1.1418E+00	1.8468E+02
α_4	2.84E-05	3.19E-03	1.67E-03	1.15E-02	0.00E+00	5.9222E-01	1.8523E+02
α_5	4.99E-09	1.20E-03	1.62E-04	5.99E-03	0.00E+00	2.2220E-01	1.8560E+02
α_6	7.58E-19	4.48E-04	7.83E-07	2.61E-03	0.00E+00	8.3237E-02	1.8574E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9567680	0.9747350	0.9759690	0.9884960	1.0000000	2.4865E+02	6.4450E+00
α_2	3.40E-03	1.21E-02	1.09E-02	2.51E-02	0.00E+00	3.0878E+00	2.5201E+02
α_3	8.61E-04	6.39E-03	5.16E-03	1.62E-02	0.00E+00	1.6312E+00	2.5346E+02
α_4	1.94E-04	3.88E-03	2.68E-03	1.16E-02	0.00E+00	9.8887E-01	2.5411E+02
α_5	1.00E-05	2.05E-03	9.68E-04	7.73E-03	0.00E+00	5.2177E-01	2.5457E+02
α_6	2.63E-10	7.30E-04	6.23E-05	3.83E-03	0.00E+00	1.8628E-01	2.5491E+02
α_7	0.00E+00	1.14E-04	9.97E-14	4.29E-04	0.00E+00	2.9071E-02	2.5507E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9574930	0.9743420	0.9754250	0.9875060	1.0000000	2.8333E+02	7.4610E+00
α_2	3.46E-03	1.15E-02	1.04E-02	2.33E-02	0.00E+00	3.3447E+00	2.8745E+02
α_3	8.84E-04	5.98E-03	4.89E-03	1.48E-02	0.00E+00	1.7384E+00	2.8905E+02
α_4	2.79E-04	3.94E-03	2.88E-03	1.12E-02	0.00E+00	1.1465E+00	2.8964E+02
α_5	4.43E-05	2.44E-03	1.43E-03	8.25E-03	0.00E+00	7.0833E-01	2.9008E+02
α_6	7.14E-07	1.26E-03	4.13E-04	5.40E-03	0.00E+00	3.6696E-01	2.9042E+02
α_7	5.60E-14	4.23E-04	7.60E-06	2.41E-03	0.00E+00	1.2297E-01	2.9067E+02
α_8	1.05E-42	1.14E-04	1.62E-12	4.81E-04	0.00E+00	3.3124E-02	2.9076E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	64.60	64.60	64.60	64.60	64.60	64.60	64.60
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.5.6.2 HIGH PRESSURE INJECTION MOTOR OPERATED VALVE FAIL TO OPEN

System :	Chemical and volume control High pressure injection
Component :	Motor Operated Valve
Failure Mode :	Fail to open on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 30.60
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9576770	0.9894740	0.9957500	0.9999790	1.0000000	4.0846E+01	4.3452E-01
α_2	1.89E-05	1.05E-02	4.25E-03	4.23E-02	0.00E+00	4.3452E-01	4.0846E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9484180	0.9820280	0.9869470	0.9988250	1.0000000	6.0155E+01	1.1009E+00
α_2	4.30E-04	1.36E-02	8.80E-03	4.32E-02	0.00E+00	8.3366E-01	6.0422E+01
α_3	1.52E-07	4.36E-03	8.77E-04	2.07E-02	0.00E+00	2.6722E-01	6.0989E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9432610	0.9763960	0.9803120	0.9961380	1.0000000	7.6736E+01	1.8551E+00
α_2	1.29E-03	1.56E-02	1.17E-02	4.32E-02	0.00E+00	1.2281E+00	7.7363E+01
α_3	5.78E-06	5.14E-03	1.90E-03	2.13E-02	0.00E+00	4.0431E-01	7.8187E+01
α_4	1.22E-08	2.83E-03	3.87E-04	1.42E-02	0.00E+00	2.2267E-01	7.8368E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9461270	0.9728450	0.9752320	0.9914060	1.0000000	1.2676E+02	3.5382E+00
α_2	3.12E-03	1.62E-02	1.38E-02	3.76E-02	0.00E+00	2.1142E+00	1.2818E+02
α_3	3.66E-04	7.50E-03	5.18E-03	2.26E-02	0.00E+00	9.7738E-01	1.2932E+02
α_4	1.89E-06	2.87E-03	9.67E-04	1.22E-02	0.00E+00	3.7439E-01	1.2992E+02
α_5	4.58E-21	5.55E-04	3.13E-07	3.21E-03	0.00E+00	7.2277E-02	1.3023E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9468400	0.9718170	0.9738680	0.9897950	1.0000000	1.4754E+02	4.2787E+00
α_2	3.03E-03	1.47E-02	1.27E-02	3.36E-02	0.00E+00	2.2392E+00	1.4958E+02
α_3	5.29E-04	7.52E-03	5.50E-03	2.14E-02	0.00E+00	1.1418E+00	1.5068E+02
α_4	3.49E-05	3.90E-03	2.04E-03	1.41E-02	0.00E+00	5.9222E-01	1.5123E+02
α_5	6.12E-09	1.46E-03	1.98E-04	7.33E-03	0.00E+00	2.2220E-01	1.5160E+02
α_6	9.28E-19	5.48E-04	9.59E-07	3.20E-03	0.00E+00	8.3237E-02	1.5174E+02

HIGH PRESSURE INJECTION MOTOR OPERATED VALVE FAIL TO OPEN

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9501810	0.9708500	0.9722560	0.9867090	1.0000000	2.1465E+02	6.4450E+00
α_2	3.93E-03	1.40E-02	1.25E-02	2.89E-02	0.00E+00	3.0878E+00	2.1801E+02
α_3	9.94E-04	7.38E-03	5.95E-03	1.86E-02	0.00E+00	1.6312E+00	2.1946E+02
α_4	2.24E-04	4.47E-03	3.10E-03	1.34E-02	0.00E+00	9.8887E-01	2.2011E+02
α_5	1.16E-05	2.36E-03	1.12E-03	8.92E-03	0.00E+00	5.2177E-01	2.2057E+02
α_6	3.04E-10	8.43E-04	7.19E-05	4.42E-03	0.00E+00	1.8628E-01	2.2091E+02
α_7	0.00E+00	1.31E-04	1.15E-13	4.95E-04	0.00E+00	2.9071E-02	2.2107E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9519050	0.9709450	0.9721580	0.9858350	1.0000000	2.4933E+02	7.4610E+00
α_2	3.92E-03	1.30E-02	1.18E-02	2.64E-02	0.00E+00	3.3447E+00	2.5345E+02
α_3	1.00E-03	6.77E-03	5.54E-03	1.67E-02	0.00E+00	1.7384E+00	2.5505E+02
α_4	3.16E-04	4.46E-03	3.26E-03	1.27E-02	0.00E+00	1.1465E+00	2.5564E+02
α_5	5.02E-05	2.76E-03	1.62E-03	9.34E-03	0.00E+00	7.0833E-01	2.5608E+02
α_6	8.09E-07	1.43E-03	4.68E-04	6.11E-03	0.00E+00	3.6696E-01	2.5642E+02
α_7	6.34E-14	4.79E-04	8.61E-06	2.73E-03	0.00E+00	1.2297E-01	2.5667E+02
α_8	1.19E-42	1.29E-04	1.84E-12	5.45E-04	0.00E+00	3.3124E-02	2.5676E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	30.60	30.60	30.60	30.60	30.60	30.60	30.60
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.5.6.3 HIGH PRESSURE INJECTION MOTOR OPERATED VALVE FAIL TO CLOSE

System :	Chemical and volume control High pressure injection
Component :	Motor Operated Valve
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 30.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9570560	0.9893190	0.9956920	0.9999790	1.0000000	4.0246E+01	4.3452E-01
α_2	1.92E-05	1.07E-02	4.31E-03	4.29E-02	0.00E+00	4.3452E-01	4.0246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9479120	0.9818500	0.9868160	0.9988130	1.0000000	5.9555E+01	1.1009E+00
α_2	4.34E-04	1.37E-02	8.89E-03	4.36E-02	0.00E+00	8.3366E-01	5.9822E+01
α_3	1.54E-07	4.41E-03	8.86E-04	2.09E-02	0.00E+00	2.6722E-01	6.0389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9428290	0.9762140	0.9801600	0.9961080	1.0000000	7.6136E+01	1.8551E+00
α_2	1.30E-03	1.57E-02	1.18E-02	4.36E-02	0.00E+00	1.2281E+00	7.6763E+01
α_3	5.83E-06	5.18E-03	1.92E-03	2.14E-02	0.00E+00	4.0431E-01	7.7587E+01
α_4	1.23E-08	2.86E-03	3.90E-04	1.43E-02	0.00E+00	2.2267E-01	7.7768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9458810	0.9727190	0.9751170	0.9913660	1.0000000	1.2616E+02	3.5382E+00
α_2	3.13E-03	1.63E-02	1.39E-02	3.77E-02	0.00E+00	2.1142E+00	1.2758E+02
α_3	3.68E-04	7.54E-03	5.20E-03	2.27E-02	0.00E+00	9.7738E-01	1.2872E+02
α_4	1.90E-06	2.89E-03	9.72E-04	1.23E-02	0.00E+00	3.7439E-01	1.2932E+02
α_5	4.60E-21	5.57E-04	3.15E-07	3.22E-03	0.00E+00	7.2277E-02	1.2963E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9466310	0.9717050	0.9737640	0.9897540	1.0000000	1.4694E+02	4.2787E+00
α_2	3.04E-03	1.48E-02	1.27E-02	3.37E-02	0.00E+00	2.2392E+00	1.4898E+02
α_3	5.31E-04	7.55E-03	5.52E-03	2.15E-02	0.00E+00	1.1418E+00	1.5008E+02
α_4	3.50E-05	3.92E-03	2.05E-03	1.41E-02	0.00E+00	5.9222E-01	1.5063E+02
α_5	6.14E-09	1.47E-03	1.99E-04	7.36E-03	0.00E+00	2.2220E-01	1.5100E+02
α_6	9.32E-19	5.50E-04	9.62E-07	3.21E-03	0.00E+00	8.3237E-02	1.5114E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9500460	0.9707700	0.9721810	0.9866720	1.0000000	2.1405E+02	6.4450E+00
α_2	3.94E-03	1.40E-02	1.26E-02	2.90E-02	0.00E+00	3.0878E+00	2.1741E+02
α_3	9.97E-04	7.40E-03	5.97E-03	1.87E-02	0.00E+00	1.6312E+00	2.1886E+02
α_4	2.25E-04	4.48E-03	3.10E-03	1.35E-02	0.00E+00	9.8887E-01	2.1951E+02
α_5	1.16E-05	2.37E-03	1.12E-03	8.94E-03	0.00E+00	5.2177E-01	2.1997E+02
α_6	3.05E-10	8.45E-04	7.21E-05	4.43E-03	0.00E+00	1.8628E-01	2.2031E+02
α_7	0.00E+00	1.32E-04	1.15E-13	4.96E-04	0.00E+00	2.9071E-02	2.2047E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9517930	0.9708770	0.9720930	0.9858020	1.0000000	2.4873E+02	7.4610E+00
α_2	3.93E-03	1.31E-02	1.18E-02	2.64E-02	0.00E+00	3.3447E+00	2.5285E+02
α_3	1.00E-03	6.79E-03	5.55E-03	1.68E-02	0.00E+00	1.7384E+00	2.5445E+02
α_4	3.17E-04	4.48E-03	3.27E-03	1.28E-02	0.00E+00	1.1465E+00	2.5504E+02
α_5	5.03E-05	2.76E-03	1.62E-03	9.36E-03	0.00E+00	7.0833E-01	2.5548E+02
α_6	8.10E-07	1.43E-03	4.69E-04	6.13E-03	0.00E+00	3.6696E-01	2.5582E+02
α_7	6.36E-14	4.80E-04	8.63E-06	2.73E-03	0.00E+00	1.2297E-01	2.5607E+02
α_8	1.19E-42	1.29E-04	1.84E-12	5.46E-04	0.00E+00	3.3124E-02	2.5616E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	30.00	30.00	30.00	30.00	30.00	30.00	30.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.5.7 PWR Residual Heat Removal Motor-Operated Valves

1.5.7.1 PWR RHR MOV FAIL TO OPEN/CLOSE

System : Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Plant Type : PWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 87.70
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9195140	0.9797630	0.9915560	0.9999550	0.9992590	2.1439E+01	4.4282E-01
α_2	4.15E-05	2.02E-02	8.44E-03	8.05E-02	7.41E-04	4.4282E-01	2.1439E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9326280	0.9762700	0.9825740	0.9983540	0.9985110	4.6320E+01	1.1259E+00
α_2	6.27E-04	1.81E-02	1.19E-02	5.67E-02	1.49E-03	8.5866E-01	4.6587E+01
α_3	1.97E-07	5.63E-03	1.14E-03	2.67E-02	0.00E+00	2.6722E-01	4.7179E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9355710	0.9729240	0.9772750	0.9953940	0.9977650	6.8456E+01	1.9051E+00
α_2	1.62E-03	1.82E-02	1.38E-02	4.95E-02	2.24E-03	1.2781E+00	6.9083E+01
α_3	6.46E-06	5.75E-03	2.13E-03	2.37E-02	0.00E+00	4.0431E-01	6.9957E+01
α_4	1.36E-08	3.16E-03	4.33E-04	1.59E-02	0.00E+00	2.2267E-01	7.0138E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9440930	0.9716290	0.9740610	0.9908570	0.9970200	1.2403E+02	3.6215E+00
α_2	3.46E-03	1.72E-02	1.48E-02	3.94E-02	2.98E-03	2.1975E+00	1.2545E+02
α_3	3.74E-04	7.66E-03	5.29E-03	2.30E-02	0.00E+00	9.7738E-01	1.2667E+02
α_4	1.93E-06	2.93E-03	9.87E-04	1.25E-02	0.00E+00	3.7439E-01	1.2728E+02
α_5	4.67E-21	5.66E-04	3.20E-07	3.28E-03	0.00E+00	7.2277E-02	1.2758E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9467150	0.9715400	0.9735520	0.9894990	0.9962700	1.5033E+02	4.4037E+00
α_2	3.33E-03	1.53E-02	1.32E-02	3.42E-02	3.73E-03	2.3642E+00	1.5237E+02
α_3	5.19E-04	7.38E-03	5.39E-03	2.10E-02	0.00E+00	1.1418E+00	1.5359E+02
α_4	3.42E-05	3.83E-03	2.00E-03	1.38E-02	0.00E+00	5.9222E-01	1.5414E+02
α_5	6.00E-09	1.44E-03	1.95E-04	7.19E-03	0.00E+00	2.2220E-01	1.5451E+02
α_6	9.11E-19	5.38E-04	9.41E-07	3.14E-03	0.00E+00	8.3237E-02	1.5465E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9510070	0.9711640	0.9725190	0.9866840	0.9955210	2.2295E+02	6.6200E+00
α_2	4.19E-03	1.42E-02	1.28E-02	2.90E-02	4.48E-03	3.2628E+00	2.2631E+02
α_3	9.57E-04	7.11E-03	5.73E-03	1.79E-02	0.00E+00	1.6312E+00	2.2794E+02
α_4	2.16E-04	4.31E-03	2.98E-03	1.29E-02	0.00E+00	9.8887E-01	2.2858E+02
α_5	1.12E-05	2.27E-03	1.08E-03	8.59E-03	0.00E+00	5.2177E-01	2.2905E+02
α_6	2.93E-10	8.11E-04	6.93E-05	4.26E-03	0.00E+00	1.8628E-01	2.2938E+02
α_7	0.00E+00	1.27E-04	1.11E-13	4.77E-04	0.00E+00	2.9071E-02	2.2954E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9532660	0.9715870	0.9727390	0.9859620	0.9947710	2.6311E+02	7.6943E+00
α_2	4.19E-03	1.32E-02	1.20E-02	2.63E-02	5.23E-03	3.5780E+00	2.6723E+02
α_3	9.49E-04	6.42E-03	5.25E-03	1.59E-02	0.00E+00	1.7384E+00	2.6907E+02
α_4	3.00E-04	4.23E-03	3.09E-03	1.21E-02	0.00E+00	1.1465E+00	2.6966E+02
α_5	4.76E-05	2.62E-03	1.54E-03	8.85E-03	0.00E+00	7.0833E-01	2.7010E+02
α_6	7.67E-07	1.36E-03	4.43E-04	5.80E-03	0.00E+00	3.6696E-01	2.7044E+02
α_7	6.01E-14	4.54E-04	8.16E-06	2.58E-03	0.00E+00	1.2297E-01	2.7068E+02
α_8	1.13E-42	1.22E-04	1.74E-12	5.17E-04	0.00E+00	3.3124E-02	2.7077E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9992590	0.9985110	0.9977650	0.9970200	0.9962700	0.9955210	0.9947710
α_2	7.41E-04	1.49E-03	2.24E-03	2.98E-03	3.73E-03	4.48E-03	5.23E-03
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.99E-01	9.99E-01	9.98E-01	9.97E-01	9.96E-01	9.96E-01	9.95E-01
Beta	7.41E-04	1.49E-03	2.24E-03	2.98E-03	3.73E-03	4.48E-03	5.23E-03
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	10.96	16.44	21.92	27.41	32.89	38.37	43.85
N_1	0.2333	0.3250	0.4000	0.4583	0.5000	0.5250	0.5333
N_2	0.0083	0.0250	0.0500	0.0833	0.1250	0.1750	0.2333
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.5.7.2 PWR RHR MOV FAIL TO OPEN

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Motor Operated Valve
Failure Mode :	Fail to open on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 57.10
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9026820	0.9754830	0.9897050	0.9999460	0.9988760	1.7619E+01	4.4282E-01
α_2	5.06E-05	2.45E-02	1.03E-02	9.73E-02	1.12E-03	4.4282E-01	1.7619E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9235030	0.9730110	0.9801420	0.9981280	0.9977400	4.0590E+01	1.1259E+00
α_2	7.15E-04	2.06E-02	1.36E-02	6.44E-02	2.26E-03	8.5866E-01	4.0857E+01
α_3	2.25E-07	6.41E-03	1.29E-03	3.04E-02	0.00E+00	2.6722E-01	4.1449E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9278310	0.9696260	0.9744770	0.9948270	0.9966060	6.0816E+01	1.9051E+00
α_2	1.83E-03	2.04E-02	1.55E-02	5.55E-02	3.39E-03	1.2781E+00	6.1443E+01
α_3	7.26E-06	6.45E-03	2.39E-03	2.66E-02	0.00E+00	4.0431E-01	6.2317E+01
α_4	1.53E-08	3.55E-03	4.86E-04	1.78E-02	0.00E+00	2.2267E-01	6.2498E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9396130	0.9693300	0.9719410	0.9901050	0.9954680	1.1446E+02	3.6215E+00
α_2	3.75E-03	1.86E-02	1.60E-02	4.25E-02	4.53E-03	2.1975E+00	1.1588E+02
α_3	4.04E-04	8.28E-03	5.72E-03	2.49E-02	0.00E+00	9.7738E-01	1.1710E+02
α_4	2.08E-06	3.17E-03	1.07E-03	1.35E-02	0.00E+00	3.7439E-01	1.1771E+02
α_5	5.05E-21	6.12E-04	3.46E-07	3.54E-03	0.00E+00	7.2277E-02	1.1801E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9424900	0.9692600	0.9714170	0.9886460	0.9943270	1.3885E+02	4.4037E+00
α_2	3.60E-03	1.65E-02	1.43E-02	3.69E-02	5.67E-03	2.3642E+00	1.4089E+02
α_3	5.61E-04	7.97E-03	5.83E-03	2.27E-02	0.00E+00	1.1418E+00	1.4211E+02
α_4	3.69E-05	4.13E-03	2.16E-03	1.49E-02	0.00E+00	5.9222E-01	1.4266E+02
α_5	6.48E-09	1.55E-03	2.10E-04	7.77E-03	0.00E+00	2.2220E-01	1.4303E+02
α_6	9.84E-19	5.81E-04	1.02E-06	3.39E-03	0.00E+00	8.3237E-02	1.4317E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9479960	0.9693760	0.9708110	0.9858440	0.9931850	2.0955E+02	6.6200E+00
α_2	4.45E-03	1.51E-02	1.36E-02	3.08E-02	6.81E-03	3.2628E+00	2.1291E+02
α_3	1.02E-03	7.55E-03	6.09E-03	1.90E-02	0.00E+00	1.6312E+00	2.1454E+02
α_4	2.29E-04	4.57E-03	3.17E-03	1.37E-02	0.00E+00	9.8887E-01	2.1518E+02
α_5	1.19E-05	2.41E-03	1.14E-03	9.12E-03	0.00E+00	5.2177E-01	2.1565E+02
α_6	3.11E-10	8.62E-04	7.36E-05	4.52E-03	0.00E+00	1.8628E-01	2.1598E+02
α_7	0.00E+00	1.34E-04	1.18E-13	5.06E-04	0.00E+00	2.9071E-02	2.1614E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9504950	0.9698860	0.9711030	0.9851130	0.9920420	2.4781E+02	7.6943E+00
α_2	4.44E-03	1.40E-02	1.28E-02	2.78E-02	7.96E-03	3.5780E+00	2.5193E+02
α_3	1.01E-03	6.80E-03	5.57E-03	1.68E-02	0.00E+00	1.7384E+00	2.5377E+02
α_4	3.18E-04	4.49E-03	3.28E-03	1.28E-02	0.00E+00	1.1465E+00	2.5436E+02
α_5	5.05E-05	2.77E-03	1.63E-03	9.38E-03	0.00E+00	7.0833E-01	2.5480E+02
α_6	8.13E-07	1.44E-03	4.70E-04	6.14E-03	0.00E+00	3.6696E-01	2.5514E+02
α_7	6.37E-14	4.81E-04	8.65E-06	2.74E-03	0.00E+00	1.2297E-01	2.5538E+02
α_8	1.19E-42	1.30E-04	1.85E-12	5.48E-04	0.00E+00	3.3124E-02	2.5547E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9988760	0.9977400	0.9966060	0.9954680	0.9943270	0.9931850	0.9920420
α_2	1.12E-03	2.26E-03	3.39E-03	4.53E-03	5.67E-03	6.81E-03	7.96E-03
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.99E-01	9.98E-01	9.97E-01	9.95E-01	9.94E-01	9.93E-01	9.92E-01
Beta	1.12E-03	2.26E-03	3.39E-03	4.53E-03	5.67E-03	6.81E-03	7.96E-03
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	7.14	10.71	14.28	17.84	21.41	24.98	28.55
N_1	0.2333	0.3250	0.4000	0.4583	0.5000	0.5250	0.5333
N_2	0.0083	0.0250	0.0500	0.0833	0.1250	0.1750	0.2333
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.5.7.3 PWR RHR MOV FAIL TO CLOSE

System : Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Plant Type : PWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 28.60
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9555320	0.9889380	0.9955360	0.9999780	1.0000000	3.8846E+01	4.3452E-01
α_2	1.99E-05	1.11E-02	4.47E-03	4.45E-02	0.00E+00	4.3452E-01	3.8846E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9466930	0.9814220	0.9865020	0.9987840	1.0000000	5.8155E+01	1.1009E+00
α_2	4.44E-04	1.41E-02	9.10E-03	4.46E-02	0.00E+00	8.3366E-01	5.8422E+01
α_3	1.58E-07	4.51E-03	9.07E-04	2.14E-02	0.00E+00	2.6722E-01	5.8989E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9417960	0.9757790	0.9797940	0.9960300	1.0000000	7.4736E+01	1.8551E+00
α_2	1.32E-03	1.60E-02	1.21E-02	4.44E-02	0.00E+00	1.2281E+00	7.5363E+01
α_3	5.93E-06	5.28E-03	1.95E-03	2.18E-02	0.00E+00	4.0431E-01	7.6187E+01
α_4	1.25E-08	2.91E-03	3.97E-04	1.46E-02	0.00E+00	2.2267E-01	7.6368E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9452960	0.9724220	0.9748440	0.9912700	1.0000000	1.2476E+02	3.5382E+00
α_2	3.17E-03	1.65E-02	1.40E-02	3.81E-02	0.00E+00	2.1142E+00	1.2618E+02
α_3	3.72E-04	7.62E-03	5.26E-03	2.29E-02	0.00E+00	9.7738E-01	1.2732E+02
α_4	1.92E-06	2.92E-03	9.82E-04	1.24E-02	0.00E+00	3.7439E-01	1.2792E+02
α_5	4.65E-21	5.63E-04	3.18E-07	3.26E-03	0.00E+00	7.2277E-02	1.2823E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9461380	0.9714410	0.9735170	0.9896570	1.0000000	1.4554E+02	4.2787E+00
α_2	3.07E-03	1.49E-02	1.28E-02	3.40E-02	0.00E+00	2.2392E+00	1.4758E+02
α_3	5.36E-04	7.62E-03	5.57E-03	2.17E-02	0.00E+00	1.1418E+00	1.4868E+02
α_4	3.53E-05	3.95E-03	2.07E-03	1.43E-02	0.00E+00	5.9222E-01	1.4923E+02
α_5	6.20E-09	1.48E-03	2.01E-04	7.43E-03	0.00E+00	2.2220E-01	1.4960E+02
α_6	9.41E-19	5.56E-04	9.71E-07	3.24E-03	0.00E+00	8.3237E-02	1.4974E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9497300	0.9705840	0.9720020	0.9865860	1.0000000	2.1265E+02	6.4450E+00
α_2	3.97E-03	1.41E-02	1.26E-02	2.92E-02	0.00E+00	3.0878E+00	2.1601E+02
α_3	1.00E-03	7.45E-03	6.01E-03	1.88E-02	0.00E+00	1.6312E+00	2.1746E+02
α_4	2.26E-04	4.51E-03	3.12E-03	1.35E-02	0.00E+00	9.8887E-01	2.1811E+02
α_5	1.17E-05	2.38E-03	1.13E-03	9.00E-03	0.00E+00	5.2177E-01	2.1857E+02
α_6	3.07E-10	8.50E-04	7.26E-05	4.46E-03	0.00E+00	1.8628E-01	2.1891E+02
α_7	0.00E+00	1.33E-04	1.16E-13	4.99E-04	0.00E+00	2.9071E-02	2.1907E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9515350	0.9707170	0.9719390	0.9857240	1.0000000	2.4733E+02	7.4610E+00
α_2	3.95E-03	1.31E-02	1.19E-02	2.66E-02	0.00E+00	3.3447E+00	2.5145E+02
α_3	1.01E-03	6.82E-03	5.58E-03	1.69E-02	0.00E+00	1.7384E+00	2.5305E+02
α_4	3.18E-04	4.50E-03	3.29E-03	1.28E-02	0.00E+00	1.1465E+00	2.5364E+02
α_5	5.06E-05	2.78E-03	1.63E-03	9.41E-03	0.00E+00	7.0833E-01	2.5408E+02
α_6	8.15E-07	1.44E-03	4.71E-04	6.16E-03	0.00E+00	3.6696E-01	2.5442E+02
α_7	6.39E-14	4.83E-04	8.68E-06	2.75E-03	0.00E+00	1.2297E-01	2.5467E+02
α_8	1.20E-42	1.30E-04	1.85E-12	5.49E-04	0.00E+00	3.3124E-02	2.5476E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	28.60	28.60	28.60	28.60	28.60	28.60	28.60
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.5.8 BWR High Pressure Coolant Injection and Reactor Core Isolation Cooling Motor-Operated Valves

1.5.8.1 COMBINED HPCI/RCIC MOTOR OPERATED VALVE FAIL TO OPEN/CLOSE

System : High pressure coolant injection
Reactor core isolation
Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 80.80
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9567310	0.9887510	0.9948830	0.9999560	0.9982730	4.3202E+01	4.9152E-01
α_2	4.11E-05	1.12E-02	5.11E-03	4.33E-02	1.73E-03	4.9152E-01	4.3202E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9569460	0.9843160	0.9881260	0.9986440	0.9968570	7.8841E+01	1.2563E+00
α_2	6.06E-04	1.23E-02	8.50E-03	3.67E-02	2.99E-03	9.8126E-01	7.9116E+01
α_3	1.61E-07	3.43E-03	7.26E-04	1.61E-02	1.58E-04	2.7502E-01	7.9822E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9567240	0.9812180	0.9839620	0.9963400	0.9957070	1.1168E+02	2.1377E+00
α_2	1.51E-03	1.30E-02	1.03E-02	3.39E-02	3.86E-03	1.4825E+00	1.1234E+02
α_3	6.45E-06	3.79E-03	1.50E-03	1.53E-02	4.13E-04	4.3151E-01	1.1339E+02
α_4	8.93E-09	1.97E-03	2.71E-04	9.83E-03	1.52E-05	2.2367E-01	1.1359E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9580710	0.9782730	0.9800010	0.9925700	0.9949700	1.7793E+02	3.9517E+00
α_2	3.07E-03	1.35E-02	1.18E-02	2.99E-02	4.18E-03	2.4579E+00	1.7942E+02
α_3	3.26E-04	5.73E-03	4.05E-03	1.69E-02	7.80E-04	1.0415E+00	1.8084E+02
α_4	1.52E-06	2.09E-03	7.14E-04	8.83E-03	6.57E-05	3.7979E-01	1.8150E+02
α_5	3.67E-21	3.98E-04	2.30E-07	2.30E-03	2.43E-06	7.2477E-02	1.8181E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9597000	0.9780230	0.9794560	0.9914430	0.9944130	2.1490E+02	4.8291E+00
α_2	2.98E-03	1.21E-02	1.07E-02	2.62E-02	4.32E-03	2.6645E+00	2.1706E+02
α_3	4.83E-04	5.69E-03	4.28E-03	1.57E-02	1.10E-03	1.2506E+00	2.1848E+02
α_4	2.75E-05	2.76E-03	1.47E-03	9.89E-03	1.54E-04	6.0742E-01	2.1912E+02
α_5	4.51E-09	1.02E-03	1.39E-04	5.08E-03	1.12E-05	2.2330E-01	2.1951E+02
α_6	6.41E-19	3.79E-04	6.62E-07	2.21E-03	0.00E+00	8.3237E-02	2.1965E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9982730	0.9968570	0.9957070	0.9949700	0.9944130
α_2	1.73E-03	2.99E-03	3.86E-03	4.18E-03	4.32E-03
α_3		1.58E-04	4.13E-04	7.80E-04	1.10E-03
α_4			1.52E-05	6.57E-05	1.54E-04
α_5				2.43E-06	1.12E-05
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.98E-01	9.97E-01	9.96E-01	9.95E-01	9.94E-01
Beta	1.73E-03	3.14E-03	4.29E-03	5.03E-03	5.59E-03
Gamma		5.02E-02	9.98E-02	1.69E-01	2.27E-01
Delta			3.55E-02	8.03E-02	1.30E-01
Epsilon				3.57E-02	6.75E-02
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	32.32	48.48	64.64	80.80	96.96
N_1	0.6360	0.8064	0.9056	0.9685	0.9977
N_2	0.0570	0.1476	0.2544	0.3437	0.4253
N_3		0.0078	0.0272	0.0641	0.1088
N_4			0.0010	0.0054	0.0152
N_5				0.0002	0.0011
N_6					0.0000

1.5.8.2 COMBINED HPCI AND RCIC MOTOR OPERATED VALVE FAIL TO OPEN

System :	High pressure coolant injection Reactor core isolation
Component :	Motor Operated Valve
Failure Mode :	Fail to open on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 41.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9285540	0.9821450	0.9926870	0.9999640	0.9998550	2.4012E+01	4.3652E-01
α_2	3.34E-05	1.79E-02	7.32E-03	7.14E-02	1.45E-04	4.3652E-01	2.4012E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9383030	0.9784230	0.9842660	0.9985670	0.9997090	5.0193E+01	1.1069E+00
α_2	5.29E-04	1.64E-02	1.06E-02	5.17E-02	2.86E-04	8.3956E-01	5.0460E+01
α_3	1.83E-07	5.21E-03	1.05E-03	2.47E-02	4.84E-06	2.6732E-01	5.1033E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9407250	0.9752790	0.9793480	0.9959130	0.9995780	7.3643E+01	1.8667E+00
α_2	1.38E-03	1.64E-02	1.24E-02	4.53E-02	4.14E-04	1.2395E+00	7.4270E+01
α_3	6.04E-06	5.36E-03	1.98E-03	2.21E-02	7.27E-06	4.0451E-01	7.5105E+01
α_4	1.27E-08	2.95E-03	4.03E-04	1.48E-02	0.00E+00	2.2267E-01	7.5287E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9474360	0.9734730	0.9757960	0.9915780	0.9994480	1.3054E+02	3.5572E+00
α_2	3.09E-03	1.59E-02	1.36E-02	3.67E-02	5.38E-04	2.1327E+00	1.3196E+02
α_3	3.56E-04	7.29E-03	5.03E-03	2.19E-02	1.45E-05	9.7788E-01	1.3312E+02
α_4	1.83E-06	2.79E-03	9.39E-04	1.19E-02	0.00E+00	3.7439E-01	1.3372E+02
α_5	4.45E-21	5.39E-04	3.05E-07	3.12E-03	0.00E+00	7.2277E-02	1.3402E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9500550	0.9734950	0.9754180	0.9903680	0.9993220	1.5818E+02	4.3067E+00
α_2	2.90E-03	1.39E-02	1.20E-02	3.16E-02	6.54E-04	2.2662E+00	1.6022E+02
α_3	4.95E-04	7.03E-03	5.14E-03	2.00E-02	2.42E-05	1.1428E+00	1.6134E+02
α_4	3.26E-05	3.64E-03	1.91E-03	1.32E-02	0.00E+00	5.9222E-01	1.6189E+02
α_5	5.71E-09	1.37E-03	1.85E-04	6.85E-03	0.00E+00	2.2220E-01	1.6226E+02
α_6	8.67E-19	5.12E-04	8.95E-07	2.99E-03	0.00E+00	8.3237E-02	1.6240E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9998550	0.9997090	0.9995780	0.9994480	0.9993220
α_2	1.45E-04	2.86E-04	4.14E-04	5.38E-04	6.54E-04
α_3		4.84E-06	7.27E-06	1.45E-05	2.42E-05
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01
Beta	1.45E-04	2.91E-04	4.22E-04	5.52E-04	6.78E-04
Gamma		1.67E-02	1.72E-02	2.63E-02	3.57E-02
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	13.67	20.50	27.33	34.17	41.00
N_1	0.0960	0.1382	0.1766	0.2115	0.2430
N_2	0.0020	0.0059	0.0114	0.0185	0.0270
N_3		0.0001	0.0002	0.0005	0.0010
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.5.8.3 COMBINED HPCI AND RCIC MOTOR OPERATED VALVE FAIL TO CLOSE

System :	High pressure coolant injection Reactor core isolation
Component :	Motor Operated Valve
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 34.80
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9344180	0.9829290	0.9922060	0.9999350	0.9969440	2.8186E+01	4.8952E-01
α_2	6.15E-05	1.71E-02	7.79E-03	6.56E-02	3.06E-03	4.8952E-01	2.8186E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9404600	0.9782800	0.9835330	0.9981310	0.9944420	5.6323E+01	1.2505E+00
α_2	8.30E-04	1.69E-02	1.18E-02	5.08E-02	5.27E-03	9.7546E-01	5.6598E+01
α_3	2.24E-07	4.78E-03	1.01E-03	2.25E-02	2.90E-04	2.7502E-01	5.7298E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9416070	0.9746260	0.9783060	0.9950640	0.9924300	8.1665E+01	2.1261E+00
α_2	2.02E-03	1.76E-02	1.39E-02	4.56E-02	6.79E-03	1.4711E+00	8.2320E+01
α_3	8.76E-06	5.15E-03	2.04E-03	2.08E-02	7.54E-04	4.3131E-01	8.3360E+01
α_4	1.22E-08	2.67E-03	3.69E-04	1.34E-02	2.79E-05	2.2367E-01	8.3567E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9474600	0.9727570	0.9749150	0.9906860	0.9911670	1.4042E+02	3.9327E+00
α_2	3.81E-03	1.69E-02	1.47E-02	3.74E-02	7.28E-03	2.4394E+00	1.4191E+02
α_3	4.11E-04	7.21E-03	5.10E-03	2.12E-02	1.42E-03	1.0410E+00	1.4331E+02
α_4	1.91E-06	2.63E-03	9.01E-04	1.11E-02	1.21E-04	3.7979E-01	1.4397E+02
α_5	4.63E-21	5.02E-04	2.90E-07	2.91E-03	4.48E-06	7.2477E-02	1.4428E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9496240	0.9725170	0.9743040	0.9893070	0.9902310	1.6989E+02	4.8011E+00
α_2	3.68E-03	1.51E-02	1.33E-02	3.27E-02	7.45E-03	2.6375E+00	1.7205E+02
α_3	6.06E-04	7.15E-03	5.38E-03	1.98E-02	2.02E-03	1.2496E+00	1.7344E+02
α_4	3.46E-05	3.48E-03	1.85E-03	1.24E-02	2.84E-04	6.0742E-01	1.7408E+02
α_5	5.68E-09	1.28E-03	1.75E-04	6.39E-03	2.06E-05	2.2330E-01	1.7447E+02
α_6	8.06E-19	4.76E-04	8.33E-07	2.78E-03	0.00E+00	8.3237E-02	1.7461E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9969440	0.9944420	0.9924300	0.9911670	0.9902310
α_2	3.06E-03	5.27E-03	6.79E-03	7.28E-03	7.45E-03
α_3		2.90E-04	7.54E-04	1.42E-03	2.02E-03
α_4			2.79E-05	1.21E-04	2.84E-04
α_5				4.48E-06	2.06E-05
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.97E-01	9.94E-01	9.92E-01	9.91E-01	9.90E-01
Beta	3.06E-03	5.56E-03	7.57E-03	8.83E-03	9.77E-03
Gamma		5.21E-02	1.03E-01	1.75E-01	2.38E-01
Delta			3.57E-02	8.09E-02	1.31E-01
Epsilon				3.57E-02	6.75E-02
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	17.40	26.10	34.80	43.50	52.20
N_1	0.5400	0.6683	0.7290	0.7570	0.7547
N_2	0.0550	0.1418	0.2430	0.3252	0.3983
N_3		0.0078	0.0270	0.0636	0.1078
N_4			0.0010	0.0054	0.0152
N_5				0.0002	0.0011
N_6					0.0000

1.5.9 Pressurizer PORV Motor-Operated Block Valves

1.5.9.1 PRESSURIZER PORV BLOCK MOVS FAIL TO OPEN

System :	Reactor coolant
Component :	Motor Operated Valve
Failure Mode :	Fail to open on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 5.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8894200	0.9722890	0.9885280	0.9999450	1.0000000	1.5246E+01	4.3452E-01
α_2	5.13E-05	2.77E-02	1.15E-02	1.11E-01	0.00E+00	4.3452E-01	1.5246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9119790	0.9691250	0.9774000	0.9979500	1.0000000	3.4555E+01	1.1009E+00
α_2	7.46E-04	2.34E-02	1.52E-02	7.38E-02	0.00E+00	8.3366E-01	3.4822E+01
α_3	2.64E-07	7.49E-03	1.52E-03	3.55E-02	0.00E+00	2.6722E-01	3.5389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9162960	0.9649930	0.9706750	0.9942240	1.0000000	5.1136E+01	1.8551E+00
α_2	1.92E-03	2.32E-02	1.75E-02	6.39E-02	0.00E+00	1.2281E+00	5.1763E+01
α_3	8.61E-06	7.63E-03	2.84E-03	3.15E-02	0.00E+00	4.0431E-01	5.2587E+01
α_4	1.82E-08	4.20E-03	5.77E-04	2.11E-02	0.00E+00	2.2267E-01	5.2768E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	5.00	5.00	5.00
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.5.9.2 PRESSURIZER PORV BLOCK MOVS FAIL TO CLOSE

System :	Reactor coolant
Component :	Motor Operated Valve
Failure Mode :	Fail to close (reseat) on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 5.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8894200	0.9722890	0.9885280	0.9999450	1.0000000	1.5246E+01	4.3452E-01
α_2	5.13E-05	2.77E-02	1.15E-02	1.11E-01	0.00E+00	4.3452E-01	1.5246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9119790	0.9691250	0.9774000	0.9979500	1.0000000	3.4555E+01	1.1009E+00
α_2	7.46E-04	2.34E-02	1.52E-02	7.38E-02	0.00E+00	8.3366E-01	3.4822E+01
α_3	2.64E-07	7.49E-03	1.52E-03	3.55E-02	0.00E+00	2.6722E-01	3.5389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9162960	0.9649930	0.9706750	0.9942240	1.0000000	5.1136E+01	1.8551E+00
α_2	1.92E-03	2.32E-02	1.75E-02	6.39E-02	0.00E+00	1.2281E+00	5.1763E+01
α_3	8.61E-06	7.63E-03	2.84E-03	3.15E-02	0.00E+00	4.0431E-01	5.2587E+01
α_4	1.82E-08	4.20E-03	5.77E-04	2.11E-02	0.00E+00	2.2267E-01	5.2768E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	5.00	5.00	5.00
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.6 Air Operated Valves

1.6.1 Pooled Air Operated Valves

1.6.1.1 AOV FAIL TO OPEN/CLOSE ALL SYSTEMS SPAR: AOV-FO

Component : Air Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 234.10
Total Number of Common-Cause Failure Events: 12

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9390010	0.9694290	0.9721660	0.9904990	0.9704870	1.0934E+02	3.4481E+00
α_2	9.50E-03	3.06E-02	2.78E-02	6.10E-02	2.95E-02	3.4481E+00	1.0934E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9399680	0.9649220	0.9666230	0.9840730	0.9650920	1.7484E+02	6.3559E+00
α_2	8.26E-03	2.32E-02	2.14E-02	4.40E-02	2.23E-02	4.1958E+00	1.7700E+02
α_3	2.34E-03	1.19E-02	1.02E-02	2.75E-02	1.26E-02	2.1601E+00	1.7904E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9420320	0.9635410	0.9647880	0.9807890	0.9640720	2.3735E+02	8.9811E+00
α_2	8.24E-03	2.06E-02	1.93E-02	3.73E-02	1.94E-02	5.0702E+00	2.4126E+02
α_3	1.84E-03	9.04E-03	7.74E-03	2.06E-02	9.18E-03	2.2257E+00	2.4411E+02
α_4	9.67E-04	6.84E-03	5.56E-03	1.71E-02	7.37E-03	1.6852E+00	2.4465E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9472440	0.9648930	0.9657840	0.9794940	0.9650480	3.3335E+02	1.2129E+01
α_2	8.84E-03	1.92E-02	1.83E-02	3.27E-02	1.84E-02	6.6290E+00	3.3885E+02
α_3	1.53E-03	6.94E-03	6.02E-03	1.55E-02	5.78E-03	2.3988E+00	3.4308E+02
α_4	1.25E-03	6.30E-03	5.38E-03	1.45E-02	7.34E-03	2.1773E+00	3.4330E+02
α_5	1.12E-04	2.67E-03	1.80E-03	8.23E-03	3.46E-03	9.2358E-01	3.4456E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9504520	0.9662080	0.9669570	0.9794070	0.9668300	4.0021E+02	1.3997E+01
α_2	7.91E-03	1.68E-02	1.60E-02	2.83E-02	1.61E-02	6.9613E+00	4.0725E+02
α_3	1.78E-03	6.85E-03	6.07E-03	1.46E-02	5.78E-03	2.8365E+00	4.1137E+02
α_4	7.52E-04	4.55E-03	3.78E-03	1.10E-02	4.42E-03	1.8860E+00	4.1232E+02
α_5	5.94E-04	4.12E-03	3.36E-03	1.03E-02	5.07E-03	1.7084E+00	4.1250E+02
α_6	1.42E-05	1.46E-03	7.74E-04	5.24E-03	1.78E-03	6.0484E-01	4.1360E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9546350	0.9680940	0.9686780	0.9795510	0.9691740	5.1364E+02	1.6928E+01
α_2	6.93E-03	1.42E-02	1.36E-02	2.36E-02	1.31E-02	7.5399E+00	5.2303E+02
α_3	2.42E-03	7.26E-03	6.65E-03	1.42E-02	6.52E-03	3.8501E+00	5.2672E+02
α_4	6.89E-04	3.81E-03	3.21E-03	9.00E-03	3.04E-03	2.0233E+00	5.2854E+02
α_5	5.44E-04	3.44E-03	2.84E-03	8.39E-03	3.84E-03	1.8263E+00	5.2874E+02
α_6	2.34E-04	2.49E-03	1.90E-03	6.77E-03	3.34E-03	1.3219E+00	5.2925E+02
α_7	3.88E-07	6.91E-04	2.26E-04	2.96E-03	9.93E-04	3.6667E-01	5.3020E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9573860	0.9695890	0.9700960	0.9800490	0.9710930	5.9460E+02	1.8650E+01
α_2	5.97E-03	1.23E-02	1.17E-02	2.04E-02	1.08E-02	7.5238E+00	6.0573E+02
α_3	2.66E-03	7.24E-03	6.71E-03	1.36E-02	6.98E-03	4.4402E+00	6.0881E+02
α_4	6.90E-04	3.52E-03	3.00E-03	8.15E-03	2.62E-03	2.1613E+00	6.1109E+02
α_5	4.10E-04	2.81E-03	2.29E-03	6.99E-03	2.62E-03	1.7242E+00	6.1153E+02
α_6	3.22E-04	2.55E-03	2.04E-03	6.55E-03	3.10E-03	1.5664E+00	6.1168E+02
α_7	7.53E-05	1.58E-03	1.08E-03	4.79E-03	2.19E-03	9.7037E-01	6.1228E+02
α_8	1.27E-08	4.29E-04	8.32E-05	2.05E-03	5.95E-04	2.6332E-01	6.1299E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9704870	0.9650920	0.9640720	0.9650480	0.9668300	0.9691740	0.9710930
α_2	2.95E-02	2.23E-02	1.94E-02	1.84E-02	1.61E-02	1.31E-02	1.08E-02
α_3		1.26E-02	9.18E-03	5.78E-03	5.78E-03	6.52E-03	6.98E-03
α_4			7.37E-03	7.34E-03	4.42E-03	3.04E-03	2.62E-03
α_5				3.46E-03	5.07E-03	3.84E-03	2.62E-03
α_6					1.78E-03	3.34E-03	3.10E-03
α_7						9.93E-04	2.19E-03
α_8							5.95E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.70E-01	9.65E-01	9.64E-01	9.65E-01	9.67E-01	9.69E-01	9.71E-01
Beta	2.95E-02	3.49E-02	3.59E-02	3.50E-02	3.32E-02	3.08E-02	2.89E-02
Gamma		3.60E-01	4.61E-01	4.74E-01	5.14E-01	5.75E-01	6.26E-01
Delta			4.45E-01	6.51E-01	6.61E-01	6.32E-01	6.15E-01
Epsilon				3.21E-01	6.08E-01	7.29E-01	7.64E-01
Mu					2.60E-01	5.30E-01	6.91E-01
Upsilon						2.29E-01	4.73E-01
Sigma							2.14E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	93.64	140.46	187.28	234.10	280.92	327.74	374.56
N_1	5.4562	4.8221	3.9348	3.0880	2.3520	1.8520	1.3101
N_2	3.0136	3.3621	3.8421	4.5148	4.7221	4.4521	4.1791
N_3		1.8929	1.8214	1.4214	1.6947	2.2189	2.7018
N_4			1.4625	1.8029	1.2938	1.0344	1.0148
N_5				0.8513	1.4862	1.3045	1.0159
N_6					0.5216	1.1356	1.1994
N_7						0.3376	0.8474
N_8							0.2302

1.6.1.2 AOV FAIL TO OPEN ALL SYSTEMS SPAR: AOV-CC

Component :	Air Operated Valve
Failure Mode :	Fail to open on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 135.20
Total Number of Common-Cause Failure Events: 5

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9551230	0.9854270	0.9902050	0.9994120	0.9908440	6.1260E+01	9.0592E-01
α_2	5.85E-04	1.46E-02	9.79E-03	4.49E-02	9.16E-03	9.0592E-01	6.1260E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9522610	0.9788880	0.9817910	0.9955960	0.9848080	1.0503E+02	2.2652E+00
α_2	2.88E-03	1.75E-02	1.46E-02	4.19E-02	1.36E-02	1.8730E+00	1.0542E+02
α_3	3.34E-06	3.66E-03	1.30E-03	1.53E-02	1.63E-03	3.9222E-01	1.0690E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9498310	0.9741060	0.9761950	0.9912510	0.9801390	1.4563E+02	3.8712E+00
α_2	5.29E-03	1.96E-02	1.75E-02	4.11E-02	1.68E-02	2.9317E+00	1.4657E+02
α_3	5.92E-05	4.38E-03	2.45E-03	1.52E-02	2.46E-03	6.5431E-01	1.4885E+02
α_4	1.27E-07	1.91E-03	4.29E-04	8.87E-03	6.16E-04	2.8517E-01	1.4922E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9514950	0.9716720	0.9730550	0.9871330	0.9773310	2.1947E+02	6.3985E+00
α_2	7.13E-03	1.94E-02	1.80E-02	3.65E-02	1.80E-02	4.3910E+00	2.2148E+02
α_3	6.15E-04	6.08E-03	4.70E-03	1.63E-02	3.14E-03	1.3732E+00	2.2450E+02
α_4	1.26E-05	2.35E-03	1.13E-03	8.83E-03	1.24E-03	5.3069E-01	2.2534E+02
α_5	7.43E-16	4.59E-04	3.36E-06	2.66E-03	2.48E-04	1.0358E-01	2.2576E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9516260	0.9702760	0.9714210	0.9850090	0.9747610	2.6379E+02	8.0811E+00
α_2	7.78E-03	1.91E-02	1.80E-02	3.45E-02	1.97E-02	5.2047E+00	2.6667E+02
α_3	7.95E-04	5.96E-03	4.80E-03	1.51E-02	3.18E-03	1.6210E+00	2.7025E+02
α_4	9.89E-05	3.09E-03	1.99E-03	9.84E-03	1.65E-03	8.4052E-01	2.7103E+02
α_5	1.98E-07	1.16E-03	3.08E-04	5.23E-03	6.23E-04	3.1600E-01	2.7156E+02
α_6	1.54E-16	3.64E-04	2.01E-06	2.11E-03	1.04E-04	9.8837E-02	2.7177E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9542640	0.9701890	0.9710450	0.9832030	0.9745660	3.5462E+02	1.0896E+01
α_2	7.70E-03	1.72E-02	1.63E-02	2.96E-02	1.82E-02	6.2752E+00	3.5924E+02
α_3	1.39E-03	6.44E-03	5.56E-03	1.45E-02	4.13E-03	2.3535E+00	3.6316E+02
α_4	3.26E-04	3.56E-03	2.71E-03	9.72E-03	1.79E-03	1.3017E+00	3.6421E+02
α_5	3.08E-05	1.88E-03	1.09E-03	6.44E-03	9.51E-04	6.8817E-01	3.6483E+02
α_6	7.34E-09	6.59E-04	1.07E-04	3.23E-03	3.13E-04	2.4098E-01	3.6528E+02
α_7	8.20E-39	1.01E-04	1.09E-11	4.61E-04	4.46E-05	3.6871E-02	3.6548E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9557230	0.9703660	0.9710990	0.9825080	0.9741690	4.1287E+02	1.2609E+01
α_2	7.55E-03	1.61E-02	1.54E-02	2.73E-02	1.77E-02	6.8657E+00	4.1861E+02
α_3	1.47E-03	6.12E-03	5.37E-03	1.34E-02	4.35E-03	2.6051E+00	4.2287E+02
α_4	4.40E-04	3.61E-03	2.86E-03	9.31E-03	1.95E-03	1.5342E+00	4.2394E+02
α_5	9.52E-05	2.20E-03	1.49E-03	6.74E-03	1.14E-03	9.3553E-01	4.2454E+02
α_6	3.41E-06	1.12E-03	4.89E-04	4.38E-03	5.51E-04	4.7676E-01	4.2500E+02
α_7	5.48E-12	3.63E-04	1.67E-05	1.99E-03	1.57E-04	1.5427E-01	4.2532E+02
α_8	9.86E-39	8.70E-05	1.01E-11	3.98E-04	1.96E-05	3.7024E-02	4.2544E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9908440	0.9848080	0.9801390	0.9773310	0.9747610	0.9745660	0.9741690
α_2	9.16E-03	1.36E-02	1.68E-02	1.80E-02	1.97E-02	1.82E-02	1.77E-02
α_3		1.63E-03	2.46E-03	3.14E-03	3.18E-03	4.13E-03	4.35E-03
α_4			6.16E-04	1.24E-03	1.65E-03	1.79E-03	1.95E-03
α_5				2.48E-04	6.23E-04	9.51E-04	1.14E-03
α_6					1.04E-04	3.13E-04	5.51E-04
α_7						4.46E-05	1.57E-04
α_8							1.96E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.91E-01	9.85E-01	9.80E-01	9.77E-01	9.75E-01	9.75E-01	9.74E-01
Beta	9.16E-03	1.52E-02	1.99E-02	2.27E-02	2.52E-02	2.54E-02	2.58E-02
Gamma		1.07E-01	1.55E-01	2.04E-01	2.20E-01	2.84E-01	3.16E-01
Delta			2.00E-01	3.22E-01	4.27E-01	4.29E-01	4.67E-01
Epsilon				1.67E-01	3.06E-01	4.23E-01	4.90E-01
Mu					1.43E-01	2.73E-01	3.90E-01
Upsilon						1.25E-01	2.43E-01
Sigma							1.11E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	48.29	72.43	96.57	120.71	144.86	169.00	193.14
N_1	2.7238	3.0464	2.9262	2.6027	1.9926	1.5674	0.9958
N_2	0.4714	1.0393	1.7036	2.2768	2.9655	3.1874	3.5210
N_3		0.1250	0.2500	0.3958	0.4792	0.7223	0.8667
N_4			0.0625	0.1563	0.2483	0.3128	0.3877
N_5				0.0313	0.0938	0.1664	0.2272
N_6					0.0156	0.0547	0.1098
N_7						0.0078	0.0313
N_8							0.0039

1.6.1.3 AOV FAIL TO CLOSE ALL SYSTEMS SPAR: AOV-OO

Component : Air Operated Valve
Failure Mode : Fail to close (reseat) on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 93.40
Total Number of Common-Cause Failure Events: 7

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8920970	0.9476270	0.9528140	0.9854120	0.9449220	5.3858E+01	2.9766E+00
α_2	1.46E-02	5.24E-02	4.72E-02	1.08E-01	5.51E-02	2.9766E+00	5.3858E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9053540	0.9469330	0.9499560	0.9781720	0.9391040	9.2641E+01	5.1917E+00
α_2	9.34E-03	3.23E-02	2.91E-02	6.59E-02	3.46E-02	3.1566E+00	9.4676E+01
α_3	3.83E-03	2.08E-02	1.76E-02	4.86E-02	2.63E-02	2.0351E+00	9.5798E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9144050	0.9487310	0.9509260	0.9755660	0.9418450	1.2889E+02	6.9651E+00
α_2	7.53E-03	2.48E-02	2.25E-02	4.99E-02	2.43E-02	3.3667E+00	1.3249E+02
α_3	2.57E-03	1.45E-02	1.22E-02	3.44E-02	1.79E-02	1.9757E+00	1.3388E+02
α_4	1.60E-03	1.19E-02	9.65E-03	3.01E-02	1.59E-02	1.6227E+00	1.3423E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9297670	0.9554630	0.9569140	0.9761920	0.9471400	1.9884E+02	9.2686E+00
α_2	7.63E-03	2.09E-02	1.94E-02	3.94E-02	2.06E-02	4.3522E+00	2.0376E+02
α_3	1.72E-03	9.62E-03	8.10E-03	2.27E-02	9.46E-03	2.0030E+00	2.0611E+02
α_4	1.76E-03	9.71E-03	8.19E-03	2.29E-02	1.52E-02	2.0211E+00	2.0609E+02
α_5	1.63E-04	4.29E-03	2.84E-03	1.33E-02	7.56E-03	8.9228E-01	2.0722E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9368380	0.9592410	0.9604640	0.9774770	0.9541050	2.3993E+02	1.0195E+01
α_2	5.49E-03	1.60E-02	1.47E-02	3.08E-02	1.36E-02	3.9958E+00	2.4613E+02
α_3	2.04E-03	9.42E-03	8.15E-03	2.12E-02	9.43E-03	2.3573E+00	2.4777E+02
α_4	8.87E-04	6.55E-03	5.29E-03	1.65E-02	8.11E-03	1.6378E+00	2.4849E+02
α_5	8.55E-04	6.46E-03	5.20E-03	1.64E-02	1.08E-02	1.6146E+00	2.4851E+02
α_6	2.05E-05	2.36E-03	1.23E-03	8.52E-03	3.93E-03	5.8924E-01	2.4954E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9451250	0.9632890	0.9641980	0.9783600	0.9596210	3.2739E+02	1.2477E+01
α_2	4.66E-03	1.28E-02	1.19E-02	2.42E-02	8.47E-03	4.3525E+00	3.3551E+02
α_3	2.61E-03	9.20E-03	8.26E-03	1.90E-02	1.00E-02	3.1278E+00	3.3674E+02
α_4	7.26E-04	5.03E-03	4.10E-03	1.25E-02	4.83E-03	1.7105E+00	3.3816E+02
α_5	6.74E-04	4.88E-03	3.95E-03	1.23E-02	7.62E-03	1.6599E+00	3.3821E+02
α_6	3.24E-04	3.73E-03	2.81E-03	1.03E-02	7.24E-03	1.2672E+00	3.3860E+02
α_7	5.05E-07	1.06E-03	3.36E-04	4.55E-03	2.21E-03	3.5887E-01	3.3951E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9497070	0.9659070	0.9666910	0.9794400	0.9644330	3.8254E+02	1.3502E+01
α_2	3.47E-03	1.01E-02	9.29E-03	1.95E-02	3.87E-03	4.0028E+00	3.9204E+02
α_3	2.85E-03	9.02E-03	8.21E-03	1.80E-02	1.08E-02	3.5736E+00	3.9247E+02
α_4	6.80E-04	4.48E-03	3.68E-03	1.10E-02	3.69E-03	1.7736E+00	3.9427E+02
α_5	4.43E-04	3.78E-03	2.98E-03	9.84E-03	4.64E-03	1.4970E+00	3.9455E+02
α_6	4.12E-04	3.68E-03	2.88E-03	9.66E-03	6.41E-03	1.4566E+00	3.9459E+02
α_7	1.04E-04	2.37E-03	1.60E-03	7.26E-03	4.81E-03	9.3917E-01	3.9510E+02
α_8	1.66E-08	6.55E-04	1.23E-04	3.14E-03	1.33E-03	2.5942E-01	3.9578E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9449220	0.9391040	0.9418450	0.9471400	0.9541050	0.9596210	0.9644330
α_2	5.51E-02	3.46E-02	2.43E-02	2.06E-02	1.36E-02	8.47E-03	3.87E-03
α_3		2.63E-02	1.79E-02	9.46E-03	9.43E-03	1.00E-02	1.08E-02
α_4			1.59E-02	1.52E-02	8.11E-03	4.83E-03	3.69E-03
α_5				7.56E-03	1.08E-02	7.62E-03	4.64E-03
α_6					3.93E-03	7.24E-03	6.41E-03
α_7						2.21E-03	4.81E-03
α_8							1.33E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.45E-01	9.39E-01	9.42E-01	9.47E-01	9.54E-01	9.60E-01	9.64E-01
Beta	5.51E-02	6.09E-02	5.82E-02	5.29E-02	4.59E-02	4.04E-02	3.56E-02
Gamma		4.32E-01	5.81E-01	6.09E-01	7.03E-01	7.90E-01	8.91E-01
Delta			4.71E-01	7.06E-01	7.08E-01	6.86E-01	6.59E-01
Epsilon				3.32E-01	6.45E-01	7.79E-01	8.23E-01
Mu					2.67E-01	5.53E-01	7.30E-01
Upsilon						2.34E-01	4.89E-01
Sigma							2.17E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	40.88	61.31	81.75	102.19	122.63	143.06	163.50
N_1	2.7324	1.7757	1.0086	0.4854	0.3594	0.2845	0.3143
N_2	2.5421	2.3229	2.1386	2.2380	1.7566	1.2647	0.6581
N_3		1.7679	1.5714	1.0256	1.2155	1.4966	1.8352
N_4			1.4000	1.6467	1.0456	0.7216	0.6271
N_5				0.8200	1.3924	1.1381	0.7887
N_6					0.5060	1.0809	1.0896
N_7						0.3298	0.8162
N_8							0.2263

1.6.2 BWR Isolation Condenser Air-Operated Valves

1.6.2.1 ISO CONDENSER AOV FAIL TO OPEN/CLOSE

System : Isolation condenser
Component : Air Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 1.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.7072910	0.8822300	0.9029730	0.9858660	0.3333330	1.0746E+01	1.4345E+00
α_2	1.41E-02	1.18E-01	9.70E-02	2.93E-01	6.67E-01	1.4345E+00	1.0746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8529320	0.9351700	0.9439770	0.9872260	0.4285710	3.0305E+01	2.1009E+00
α_2	8.23E-04	2.57E-02	1.68E-02	8.11E-02	0.00E+00	8.3366E-01	3.1572E+01
α_3	3.50E-03	3.91E-02	3.00E-02	1.06E-01	5.71E-01	1.2672E+00	3.1139E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8811760	0.9428880	0.9487180	0.9846280	0.5000000	4.7136E+01	2.8551E+00
α_2	2.04E-03	2.46E-02	1.86E-02	6.77E-02	0.00E+00	1.2281E+00	4.8763E+01
α_3	9.14E-06	8.09E-03	3.01E-03	3.34E-02	0.00E+00	4.0431E-01	4.9587E+01
α_4	2.02E-03	2.45E-02	1.84E-02	6.75E-02	5.00E-01	1.2227E+00	4.8768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9177320	0.9554850	0.9584350	0.9831430	0.5555560	9.7411E+01	4.5382E+00
α_2	4.00E-03	2.07E-02	1.77E-02	4.79E-02	0.00E+00	2.1142E+00	9.9835E+01
α_3	4.69E-04	9.59E-03	6.63E-03	2.88E-02	0.00E+00	9.7738E-01	1.0097E+02
α_4	3.10E-04	8.58E-03	5.65E-03	2.68E-02	2.22E-01	8.7439E-01	1.0107E+02
α_5	4.31E-05	5.61E-03	2.87E-03	2.05E-02	2.22E-01	5.7228E-01	1.0138E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9239510	0.9573330	0.9597820	0.9823620	0.6000000	1.1844E+02	5.2787E+00
α_2	3.72E-03	1.81E-02	1.56E-02	4.11E-02	0.00E+00	2.2392E+00	1.2148E+02
α_3	6.50E-04	9.23E-03	6.75E-03	2.63E-02	0.00E+00	1.1418E+00	1.2258E+02
α_4	2.20E-04	6.81E-03	4.40E-03	2.16E-02	1.00E-01	8.4222E-01	1.2288E+02
α_5	1.14E-04	5.84E-03	3.48E-03	1.96E-02	2.00E-01	7.2220E-01	1.2300E+02
α_6	7.22E-07	2.69E-03	7.75E-04	1.19E-02	1.00E-01	3.3324E-01	1.2339E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.3333330	0.4285710	0.5000000	0.5555560	0.6000000
α_2	6.67E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		5.71E-01	0.00E+00	0.00E+00	0.00E+00
α_4			5.00E-01	2.22E-01	1.00E-01
α_5				2.22E-01	2.00E-01
α_6					1.00E-01

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	3.33E-01	4.29E-01	5.00E-01	5.56E-01	6.00E-01
Beta	6.67E-01	5.71E-01	5.00E-01	4.44E-01	4.00E-01
Gamma		1.00E+00	1.00E+00	1.00E+00	1.00E+00
Delta			1.00E+00	1.00E+00	1.00E+00
Epsilon				5.00E-01	7.50E-01
Mu					3.33E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	0.50	0.75	1.00	1.25	1.50
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	1.0000	0.0000	0.0000	0.0000	0.0000
N_3		1.0000	0.0000	0.0000	0.0000
N_4			1.0000	0.5000	0.2500
N_5				0.5000	0.5000
N_6					0.2500

1.6.2.2 ISO CONDENSER AOV FAIL TO OPEN

System :	Isolation condenser
Component :	Air Operated Valve
Failure Mode :	Fail to open on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 1.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8522320	0.9628000	0.9843830	0.9999320	1.0000000	1.1246E+01	4.3452E-01
α_2	7.00E-05	3.72E-02	1.56E-02	1.48E-01	0.00E+00	4.3452E-01	1.1246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9010680	0.9652240	0.9744830	0.9976820	1.0000000	3.0555E+01	1.1009E+00
α_2	8.43E-04	2.63E-02	1.72E-02	8.30E-02	0.00E+00	8.3366E-01	3.0822E+01
α_3	2.98E-07	8.44E-03	1.71E-03	4.00E-02	0.00E+00	2.6722E-01	3.1389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9095820	0.9621340	0.9682530	0.9937390	1.0000000	4.7136E+01	1.8551E+00
α_2	2.09E-03	2.51E-02	1.89E-02	6.90E-02	0.00E+00	1.2281E+00	4.7763E+01
α_3	9.32E-06	8.25E-03	3.07E-03	3.41E-02	0.00E+00	4.0431E-01	4.8587E+01
α_4	1.97E-08	4.55E-03	6.24E-04	2.28E-02	0.00E+00	2.2267E-01	4.8768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9304990	0.9648630	0.9678980	0.9888360	1.0000000	9.7161E+01	3.5382E+00
α_2	4.05E-03	2.10E-02	1.79E-02	4.85E-02	0.00E+00	2.1142E+00	9.8585E+01
α_3	4.74E-04	9.71E-03	6.71E-03	2.92E-02	0.00E+00	9.7738E-01	9.9722E+01
α_4	2.45E-06	3.72E-03	1.25E-03	1.58E-02	0.00E+00	3.7439E-01	1.0032E+02
α_5	5.93E-21	7.18E-04	4.06E-07	4.16E-03	0.00E+00	7.2277E-02	1.0063E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9341160	0.9649920	0.9674990	0.9872840	1.0000000	1.1794E+02	4.2787E+00
α_2	3.77E-03	1.83E-02	1.58E-02	4.16E-02	0.00E+00	2.2392E+00	1.1998E+02
α_3	6.58E-04	9.34E-03	6.84E-03	2.66E-02	0.00E+00	1.1418E+00	1.2108E+02
α_4	4.33E-05	4.85E-03	2.54E-03	1.75E-02	0.00E+00	5.9222E-01	1.2163E+02
α_5	7.60E-09	1.82E-03	2.47E-04	9.11E-03	0.00E+00	2.2220E-01	1.2200E+02
α_6	1.15E-18	6.81E-04	1.19E-06	3.98E-03	0.00E+00	8.3237E-02	1.2214E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	1.00	1.00	1.00	1.00	1.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.6.2.3 ISO CONDENSER AOV FAIL TO CLOSE

System :	Isolation condenser
Component :	Air Operated Valve
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 0.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.6956560	0.8771890	0.8985750	0.9851950	0.0000000	1.0246E+01	1.4345E+00
α_2	1.48E-02	1.23E-01	1.01E-01	3.04E-01	1.00E+00	1.4345E+00	1.0246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8495560	0.9336340	0.9426210	0.9869090	0.0000000	2.9555E+01	2.1009E+00
α_2	8.43E-04	2.63E-02	1.72E-02	8.30E-02	0.00E+00	8.3366E-01	3.0822E+01
α_3	3.59E-03	4.00E-02	3.08E-02	1.08E-01	1.00E+00	1.2672E+00	3.0389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8788090	0.9417220	0.9476570	0.9843040	0.0000000	4.6136E+01	2.8551E+00
α_2	2.09E-03	2.51E-02	1.89E-02	6.90E-02	0.00E+00	1.2281E+00	4.7763E+01
α_3	9.32E-06	8.25E-03	3.07E-03	3.41E-02	0.00E+00	4.0431E-01	4.8587E+01
α_4	2.06E-03	2.50E-02	1.88E-02	6.88E-02	1.00E+00	1.2227E+00	4.7768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9167220	0.9549330	0.9579160	0.9829300	0.0000000	9.6161E+01	4.5382E+00
α_2	4.05E-03	2.10E-02	1.79E-02	4.85E-02	0.00E+00	2.1142E+00	9.8585E+01
α_3	4.74E-04	9.71E-03	6.71E-03	2.92E-02	0.00E+00	9.7738E-01	9.9722E+01
α_4	3.14E-04	8.68E-03	5.72E-03	2.72E-02	5.00E-01	8.7439E-01	9.9825E+01
α_5	4.37E-05	5.68E-03	2.91E-03	2.07E-02	5.00E-01	5.7228E-01	1.0013E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9230310	0.9568100	0.9592860	0.9821410	0.0000000	1.1694E+02	5.2787E+00
α_2	3.77E-03	1.83E-02	1.58E-02	4.16E-02	0.00E+00	2.2392E+00	1.1998E+02
α_3	6.58E-04	9.34E-03	6.84E-03	2.66E-02	0.00E+00	1.1418E+00	1.2108E+02
α_4	2.23E-04	6.89E-03	4.45E-03	2.19E-02	2.50E-01	8.4222E-01	1.2138E+02
α_5	1.16E-04	5.91E-03	3.52E-03	1.98E-02	5.00E-01	7.2220E-01	1.2150E+02
α_6	7.30E-07	2.73E-03	7.85E-04	1.20E-02	2.50E-01	3.3324E-01	1.2189E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
α_2	1.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		1.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			1.00E+00	5.00E-01	2.50E-01
α_5				5.00E-01	5.00E-01
α_6					2.50E-01

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Gamma		1.00E+00	1.00E+00	1.00E+00	1.00E+00
Delta			1.00E+00	1.00E+00	1.00E+00
Epsilon				5.00E-01	7.50E-01
Mu					3.33E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	0.00	0.00	0.00	0.00	0.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	1.0000	0.0000	0.0000	0.0000	0.0000
N_3		1.0000	0.0000	0.0000	0.0000
N_4			1.0000	0.5000	0.2500
N_5				0.5000	0.5000
N_6					0.2500

1.6.3 PWR Auxiliary Feedwater Air-Operated Valves

1.6.3.1 AFW AOV FAIL TO OPEN/CLOSE SPAR: AOV-FO

Component : Air Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 234.10
Total Number of Common-Cause Failure Events: 12

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9390010	0.9694290	0.9721660	0.9904990	0.9704870	1.0934E+02	3.4481E+00
α_2	9.50E-03	3.06E-02	2.78E-02	6.10E-02	2.95E-02	3.4481E+00	1.0934E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9399680	0.9649220	0.9666230	0.9840730	0.9650920	1.7484E+02	6.3559E+00
α_2	8.26E-03	2.32E-02	2.14E-02	4.40E-02	2.23E-02	4.1958E+00	1.7700E+02
α_3	2.34E-03	1.19E-02	1.02E-02	2.75E-02	1.26E-02	2.1601E+00	1.7904E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9420320	0.9635410	0.9647880	0.9807890	0.9640720	2.3735E+02	8.9811E+00
α_2	8.24E-03	2.06E-02	1.93E-02	3.73E-02	1.94E-02	5.0702E+00	2.4126E+02
α_3	1.84E-03	9.04E-03	7.74E-03	2.06E-02	9.18E-03	2.2257E+00	2.4411E+02
α_4	9.67E-04	6.84E-03	5.56E-03	1.71E-02	7.37E-03	1.6852E+00	2.4465E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9472440	0.9648930	0.9657840	0.9794940	0.9650480	3.3335E+02	1.2129E+01
α_2	8.84E-03	1.92E-02	1.83E-02	3.27E-02	1.84E-02	6.6290E+00	3.3885E+02
α_3	1.53E-03	6.94E-03	6.02E-03	1.55E-02	5.78E-03	2.3988E+00	3.4308E+02
α_4	1.25E-03	6.30E-03	5.38E-03	1.45E-02	7.34E-03	2.1773E+00	3.4330E+02
α_5	1.12E-04	2.67E-03	1.80E-03	8.23E-03	3.46E-03	9.2358E-01	3.4456E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9504520	0.9662080	0.9669570	0.9794070	0.9668300	4.0021E+02	1.3997E+01
α_2	7.91E-03	1.68E-02	1.60E-02	2.83E-02	1.61E-02	6.9613E+00	4.0725E+02
α_3	1.78E-03	6.85E-03	6.07E-03	1.46E-02	5.78E-03	2.8365E+00	4.1137E+02
α_4	7.52E-04	4.55E-03	3.78E-03	1.10E-02	4.42E-03	1.8860E+00	4.1232E+02
α_5	5.94E-04	4.12E-03	3.36E-03	1.03E-02	5.07E-03	1.7084E+00	4.1250E+02
α_6	1.42E-05	1.46E-03	7.74E-04	5.24E-03	1.78E-03	6.0484E-01	4.1360E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9546350	0.9680940	0.9686780	0.9795510	0.9691740	5.1364E+02	1.6928E+01
α_2	6.93E-03	1.42E-02	1.36E-02	2.36E-02	1.31E-02	7.5399E+00	5.2303E+02
α_3	2.42E-03	7.26E-03	6.65E-03	1.42E-02	6.52E-03	3.8501E+00	5.2672E+02
α_4	6.89E-04	3.81E-03	3.21E-03	9.00E-03	3.04E-03	2.0233E+00	5.2854E+02
α_5	5.44E-04	3.44E-03	2.84E-03	8.39E-03	3.84E-03	1.8263E+00	5.2874E+02
α_6	2.34E-04	2.49E-03	1.90E-03	6.77E-03	3.34E-03	1.3219E+00	5.2925E+02
α_7	3.88E-07	6.91E-04	2.26E-04	2.96E-03	9.93E-04	3.6667E-01	5.3020E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9573860	0.9695890	0.9700960	0.9800490	0.9710930	5.9460E+02	1.8650E+01
α_2	5.97E-03	1.23E-02	1.17E-02	2.04E-02	1.08E-02	7.5238E+00	6.0573E+02
α_3	2.66E-03	7.24E-03	6.71E-03	1.36E-02	6.98E-03	4.4402E+00	6.0881E+02
α_4	6.90E-04	3.52E-03	3.00E-03	8.15E-03	2.62E-03	2.1613E+00	6.1109E+02
α_5	4.10E-04	2.81E-03	2.29E-03	6.99E-03	2.62E-03	1.7242E+00	6.1153E+02
α_6	3.22E-04	2.55E-03	2.04E-03	6.55E-03	3.10E-03	1.5664E+00	6.1168E+02
α_7	7.53E-05	1.58E-03	1.08E-03	4.79E-03	2.19E-03	9.7037E-01	6.1228E+02
α_8	1.27E-08	4.29E-04	8.32E-05	2.05E-03	5.95E-04	2.6332E-01	6.1299E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9704870	0.9650920	0.9640720	0.9650480	0.9668300	0.9691740	0.9710930
α_2	2.95E-02	2.23E-02	1.94E-02	1.84E-02	1.61E-02	1.31E-02	1.08E-02
α_3		1.26E-02	9.18E-03	5.78E-03	5.78E-03	6.52E-03	6.98E-03
α_4			7.37E-03	7.34E-03	4.42E-03	3.04E-03	2.62E-03
α_5				3.46E-03	5.07E-03	3.84E-03	2.62E-03
α_6					1.78E-03	3.34E-03	3.10E-03
α_7						9.93E-04	2.19E-03
α_8							5.95E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.70E-01	9.65E-01	9.64E-01	9.65E-01	9.67E-01	9.69E-01	9.71E-01
Beta	2.95E-02	3.49E-02	3.59E-02	3.50E-02	3.32E-02	3.08E-02	2.89E-02
Gamma		3.60E-01	4.61E-01	4.74E-01	5.14E-01	5.75E-01	6.26E-01
Delta			4.45E-01	6.51E-01	6.61E-01	6.32E-01	6.15E-01
Epsilon				3.21E-01	6.08E-01	7.29E-01	7.64E-01
Mu					2.60E-01	5.30E-01	6.91E-01
Upsilon						2.29E-01	4.73E-01
Sigma							2.14E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	93.64	140.46	187.28	234.10	280.92	327.74	374.56
N_1	5.4562	4.8221	3.9348	3.0880	2.3520	1.8520	1.3101
N_2	3.0136	3.3621	3.8421	4.5148	4.7221	4.4521	4.1791
N_3		1.8929	1.8214	1.4214	1.6947	2.2189	2.7018
N_4			1.4625	1.8029	1.2938	1.0344	1.0148
N_5				0.8513	1.4862	1.3045	1.0159
N_6					0.5216	1.1356	1.1994
N_7						0.3376	0.8474
N_8							0.2302

1.6.3.2 AFW AOV FAIL TO OPEN SPAR: AFW-AOV-CC

System :	Auxiliary feedwater
Component :	Air Operated Valve
Failure Mode :	Fail to open on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 30.60
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8947210	0.9671770	0.9790410	0.9991120	0.9734920	2.3188E+01	7.8692E-01
α_2	8.85E-04	3.28E-02	2.10E-02	1.05E-01	2.65E-02	7.8692E-01	2.3188E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9100390	0.9619870	0.9679630	0.9934770	0.9586900	4.8286E+01	1.9080E+00
α_2	3.69E-03	3.02E-02	2.42E-02	7.73E-02	3.49E-02	1.5158E+00	4.8678E+01
α_3	7.19E-06	7.81E-03	2.80E-03	3.26E-02	6.40E-03	3.9222E-01	4.9802E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9127460	0.9571120	0.9611980	0.9875050	0.9491810	7.0451E+01	3.1569E+00
α_2	6.17E-03	3.01E-02	2.60E-02	6.83E-02	3.86E-02	2.2174E+00	7.1390E+01
α_3	1.21E-04	8.89E-03	5.00E-03	3.09E-02	9.76E-03	6.5431E-01	7.2954E+01
α_4	2.59E-07	3.87E-03	8.74E-04	1.80E-02	2.44E-03	2.8517E-01	7.3323E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9272920	0.9590580	0.9613700	0.9829130	0.9418340	1.2590E+02	5.3747E+00
α_2	8.15E-03	2.63E-02	2.39E-02	5.25E-02	4.23E-02	3.4505E+00	1.2782E+02
α_3	8.88E-04	9.83E-03	7.47E-03	2.68E-02	9.90E-03	1.2899E+00	1.2998E+02
α_4	2.17E-05	4.04E-03	1.94E-03	1.52E-02	4.95E-03	5.3069E-01	1.3074E+02
α_5	1.28E-15	7.89E-04	5.78E-06	4.58E-03	9.91E-04	1.0358E-01	1.3117E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9286530	0.9577270	0.9596420	0.9802640	0.9351210	1.5191E+02	6.7051E+00
α_2	8.75E-03	2.53E-02	2.33E-02	4.85E-02	4.73E-02	4.0093E+00	1.5461E+02
α_3	1.03E-03	9.17E-03	7.20E-03	2.40E-02	8.36E-03	1.4543E+00	1.5716E+02
α_4	1.59E-04	5.21E-03	3.33E-03	1.67E-02	6.27E-03	8.2662E-01	1.5779E+02
α_5	3.40E-07	1.99E-03	5.29E-04	8.96E-03	2.51E-03	3.1600E-01	1.5830E+02
α_6	2.64E-16	6.23E-04	3.46E-06	3.63E-03	4.17E-04	9.8837E-02	1.5852E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9381070	0.9609170	0.9622240	0.9792600	0.9377640	2.2454E+02	9.1325E+00
α_2	7.97E-03	2.05E-02	1.92E-02	3.77E-02	3.97E-02	4.8019E+00	2.2887E+02
α_3	1.71E-03	9.01E-03	7.65E-03	2.09E-02	1.10E-02	2.1046E+00	2.3157E+02
α_4	4.66E-04	5.40E-03	4.07E-03	1.49E-02	6.33E-03	1.2623E+00	2.3241E+02
α_5	4.75E-05	2.94E-03	1.69E-03	1.00E-02	3.80E-03	6.8587E-01	2.3299E+02
α_6	1.15E-08	1.03E-03	1.67E-04	5.05E-03	1.27E-03	2.4098E-01	2.3343E+02
α_7	1.28E-38	1.58E-04	1.70E-11	7.21E-04	1.81E-04	3.6871E-02	2.3364E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9414850	0.9621030	0.9632170	0.9789130	0.9393990	2.6469E+02	1.0426E+01
α_2	7.43E-03	1.85E-02	1.74E-02	3.35E-02	3.58E-02	5.0941E+00	2.7002E+02
α_3	1.72E-03	8.28E-03	7.12E-03	1.88E-02	1.10E-02	2.2772E+00	2.7284E+02
α_4	5.97E-04	5.31E-03	4.17E-03	1.39E-02	6.41E-03	1.4599E+00	2.7366E+02
α_5	1.43E-04	3.37E-03	2.27E-03	1.04E-02	4.47E-03	9.2713E-01	2.7419E+02
α_6	5.25E-06	1.73E-03	7.55E-04	6.76E-03	2.24E-03	4.7636E-01	2.7464E+02
α_7	8.48E-12	5.61E-04	2.59E-05	3.07E-03	6.40E-04	1.5427E-01	2.7496E+02
α_8	1.53E-38	1.35E-04	1.56E-11	6.17E-04	7.97E-05	3.7024E-02	2.7508E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9734920	0.9586900	0.9491810	0.9418340	0.9351210	0.9377640	0.9393990
α_2	2.65E-02	3.49E-02	3.86E-02	4.23E-02	4.73E-02	3.97E-02	3.58E-02
α_3		6.40E-03	9.76E-03	9.90E-03	8.36E-03	1.10E-02	1.10E-02
α_4			2.44E-03	4.95E-03	6.27E-03	6.33E-03	6.41E-03
α_5				9.91E-04	2.51E-03	3.80E-03	4.47E-03
α_6					4.17E-04	1.27E-03	2.24E-03
α_7						1.81E-04	6.40E-04
α_8							7.97E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.73E-01	9.59E-01	9.49E-01	9.42E-01	9.35E-01	9.38E-01	9.39E-01
Beta	2.65E-02	4.13E-02	5.08E-02	5.82E-02	6.49E-02	6.22E-02	6.06E-02
Gamma		1.55E-01	2.40E-01	2.72E-01	2.70E-01	3.62E-01	4.10E-01
Delta			2.00E-01	3.75E-01	5.24E-01	5.14E-01	5.57E-01
Epsilon				1.67E-01	3.18E-01	4.53E-01	5.37E-01
Mu					1.43E-01	2.76E-01	3.98E-01
Upsilon						1.25E-01	2.43E-01
Sigma							1.11E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	11.48	17.22	22.96	28.71	34.45	40.19	45.93
N_1	1.4619	1.5107	1.3548	1.0253	0.5223	0.3047	0.0313
N_2	0.3524	0.6821	0.9893	1.3363	1.7701	1.7141	1.7494
N_3		0.1250	0.2500	0.3125	0.3125	0.4734	0.5388
N_4			0.0625	0.1563	0.2344	0.2734	0.3134
N_5				0.0313	0.0938	0.1641	0.2188
N_6					0.0156	0.0547	0.1094
N_7						0.0078	0.0313
N_8							0.0039

1.6.3.3 AFW AOV FAIL TO CLOSE SPAR: AFW-AOV-OO

System :	Auxiliary feedwater
Component :	Air Operated Valve
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 24.50
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9103770	0.9747370	0.9862920	0.9997510	0.9872320	2.3259E+01	6.0282E-01
α_2	2.51E-04	2.53E-02	1.37E-02	8.96E-02	1.28E-02	6.0282E-01	2.3259E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9197310	0.9679970	0.9740010	0.9957100	0.9741360	4.8575E+01	1.6059E+00
α_2	2.62E-03	2.67E-02	2.07E-02	7.13E-02	2.59E-02	1.3387E+00	4.8842E+01
α_3	1.86E-07	5.33E-03	1.07E-03	2.53E-02	0.00E+00	2.6722E-01	4.9914E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9185700	0.9611150	0.9652190	0.9896080	0.9606850	7.0816E+01	2.8651E+00
α_2	6.29E-03	3.04E-02	2.62E-02	6.87E-02	3.93E-02	2.2381E+00	7.1443E+01
α_3	6.17E-06	5.49E-03	2.03E-03	2.27E-02	0.00E+00	4.0431E-01	7.3277E+01
α_4	1.30E-08	3.02E-03	4.13E-04	1.51E-02	0.00E+00	2.2267E-01	7.3458E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9358640	0.9653840	0.9677160	0.9869190	0.9681140	1.2701E+02	4.5543E+00
α_2	5.50E-03	2.13E-02	1.89E-02	4.51E-02	2.14E-02	2.7965E+00	1.2877E+02
α_3	9.29E-04	9.97E-03	7.62E-03	2.70E-02	1.05E-02	1.3111E+00	1.3025E+02
α_4	1.87E-06	2.85E-03	9.58E-04	1.21E-02	0.00E+00	3.7439E-01	1.3119E+02
α_5	4.53E-21	5.49E-04	3.10E-07	3.18E-03	0.00E+00	7.2277E-02	1.3149E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9405410	0.9667060	0.9686460	0.9862560	0.9730920	1.5394E+02	5.3019E+00
α_2	4.25E-03	1.70E-02	1.50E-02	3.65E-02	1.23E-02	2.7060E+00	1.5654E+02
α_3	1.29E-03	9.97E-03	8.00E-03	2.54E-02	1.17E-02	1.5871E+00	1.5765E+02
α_4	7.85E-05	4.42E-03	2.59E-03	1.50E-02	2.92E-03	7.0332E-01	1.5854E+02
α_5	5.83E-09	1.40E-03	1.89E-04	6.99E-03	0.00E+00	2.2220E-01	1.5902E+02
α_6	8.85E-19	5.23E-04	9.14E-07	3.05E-03	0.00E+00	8.3237E-02	1.5916E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9473330	0.9681420	0.9694620	0.9844400	0.9766560	2.2721E+02	7.4767E+00
α_2	4.45E-03	1.45E-02	1.32E-02	2.93E-02	7.39E-03	3.4142E+00	2.3127E+02
α_3	1.66E-03	8.85E-03	7.50E-03	2.07E-02	1.01E-02	2.0772E+00	2.3261E+02
α_4	4.10E-04	5.16E-03	3.84E-03	1.44E-02	5.03E-03	1.2112E+00	2.3348E+02
α_5	1.63E-05	2.38E-03	1.19E-03	8.78E-03	8.37E-04	5.5877E-01	2.3413E+02
α_6	2.86E-10	7.94E-04	6.77E-05	4.17E-03	0.00E+00	1.8628E-01	2.3450E+02
α_7	0.00E+00	1.24E-04	1.08E-13	4.66E-04	0.00E+00	2.9071E-02	2.3466E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9505030	0.9692550	0.9703790	0.9841690	0.9793230	2.6804E+02	8.5022E+00
α_2	4.11E-03	1.29E-02	1.18E-02	2.57E-02	4.69E-03	3.5808E+00	2.7296E+02
α_3	1.49E-03	7.72E-03	6.57E-03	1.79E-02	7.90E-03	2.1360E+00	2.7441E+02
α_4	5.76E-04	5.22E-03	4.08E-03	1.37E-02	5.89E-03	1.4429E+00	2.7510E+02
α_5	8.24E-05	2.92E-03	1.84E-03	9.42E-03	1.96E-03	8.0713E-01	2.7574E+02
α_6	9.86E-07	1.37E-03	4.68E-04	5.80E-03	2.44E-04	3.7926E-01	2.7616E+02
α_7	5.89E-14	4.45E-04	7.99E-06	2.53E-03	0.00E+00	1.2297E-01	2.7642E+02
α_8	1.10E-42	1.20E-04	1.71E-12	5.06E-04	0.00E+00	3.3124E-02	2.7651E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9872320	0.9741360	0.9606850	0.9681140	0.9730920	0.9766560	0.9793230
α_2	1.28E-02	2.59E-02	3.93E-02	2.14E-02	1.23E-02	7.39E-03	4.69E-03
α_3		0.00E+00	0.00E+00	1.05E-02	1.17E-02	1.01E-02	7.90E-03
α_4			0.00E+00	0.00E+00	2.92E-03	5.03E-03	5.89E-03
α_5				0.00E+00	0.00E+00	8.37E-04	1.96E-03
α_6					0.00E+00	0.00E+00	2.44E-04
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.87E-01	9.74E-01	9.61E-01	9.68E-01	9.73E-01	9.77E-01	9.79E-01
Beta	1.28E-02	2.59E-02	3.93E-02	3.19E-02	2.69E-02	2.33E-02	2.07E-02
Gamma		0.00E+00	0.00E+00	3.28E-01	5.44E-01	6.84E-01	7.73E-01
Delta			0.00E+00	0.00E+00	2.00E-01	3.68E-01	5.06E-01
Epsilon				0.00E+00	0.00E+00	1.43E-01	2.73E-01
Mu					0.00E+00	0.00E+00	1.11E-01
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	12.25	18.38	24.50	30.63	36.75	42.88	49.00
N_1	0.7633	0.6400	0.1800	0.2175	0.2523	0.2845	0.3143
N_2	0.1683	0.5050	1.0100	0.6823	0.4668	0.3264	0.2361
N_3		0.0000	0.0000	0.3337	0.4453	0.4460	0.3976
N_4			0.0000	0.0000	0.1111	0.2223	0.2964
N_5				0.0000	0.0000	0.0370	0.0988
N_6					0.0000	0.0000	0.0123
N_7						0.0000	0.0000
N_8							0.0000

1.6.4 High Pressure Coolant Injection and Reactor Core Isolation Cooling Air Operated Valves

1.6.4.1 COMBINED HPCI AND RCIC AIR OPERATED VALVE FAIL TO OPEN/CLOSE

System :	High pressure coolant injection Reactor core isolation
Component :	Air Operated Valve
Failure Mode :	Fail to close (reseat) on demand Fail to Open/Close Mode Unspecified (demand based) Fail to open on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 4.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8819910	0.9704020	0.9877120	0.9999410	1.0000000	1.4246E+01	4.3452E-01
α_2	5.49E-05	2.96E-02	1.23E-02	1.18E-01	0.00E+00	4.3452E-01	1.4246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9094830	0.9682340	0.9767350	0.9978890	1.0000000	3.3555E+01	1.1009E+00
α_2	7.68E-04	2.41E-02	1.57E-02	7.59E-02	0.00E+00	8.3366E-01	3.3822E+01
α_3	2.71E-07	7.71E-03	1.56E-03	3.66E-02	0.00E+00	2.6722E-01	3.4389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9147120	0.9643190	0.9701040	0.9941100	1.0000000	5.0136E+01	1.8551E+00
α_2	1.96E-03	2.36E-02	1.78E-02	6.51E-02	0.00E+00	1.2281E+00	5.0763E+01
α_3	8.78E-06	7.78E-03	2.89E-03	3.21E-02	0.00E+00	4.0431E-01	5.1587E+01
α_4	1.85E-08	4.28E-03	5.88E-04	2.15E-02	0.00E+00	2.2267E-01	5.1768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9324830	0.9658790	0.9688380	0.9891640	1.0000000	1.0016E+02	3.5382E+00
α_2	3.93E-03	2.04E-02	1.74E-02	4.71E-02	0.00E+00	2.1142E+00	1.0158E+02
α_3	4.61E-04	9.43E-03	6.51E-03	2.83E-02	0.00E+00	9.7738E-01	1.0272E+02
α_4	2.37E-06	3.61E-03	1.22E-03	1.53E-02	0.00E+00	3.7439E-01	1.0332E+02
α_5	5.76E-21	6.97E-04	3.94E-07	4.04E-03	0.00E+00	7.2277E-02	1.0363E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9356760	0.9658310	0.9682860	0.9875940	1.0000000	1.2094E+02	4.2787E+00
α_2	3.68E-03	1.79E-02	1.54E-02	4.06E-02	0.00E+00	2.2392E+00	1.2298E+02
α_3	6.42E-04	9.12E-03	6.67E-03	2.60E-02	0.00E+00	1.1418E+00	1.2408E+02
α_4	4.23E-05	4.73E-03	2.48E-03	1.71E-02	0.00E+00	5.9222E-01	1.2463E+02
α_5	7.42E-09	1.77E-03	2.41E-04	8.89E-03	0.00E+00	2.2220E-01	1.2500E+02
α_6	1.13E-18	6.65E-04	1.16E-06	3.88E-03	0.00E+00	8.3237E-02	1.2514E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	4.00	4.00	4.00	4.00	4.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.6.4.2 COMBINED HPCI AND RCIC AIR OPERATED VALVE FAIL TO OPEN

System : High pressure coolant injection
Reactor core isolation
Component : Air Operated Valve
Failure Mode : Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 3.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8734960	0.9682380	0.9867710	0.9999360	1.0000000	1.3246E+01	4.3452E-01
α_2	5.92E-05	3.18E-02	1.32E-02	1.27E-01	0.00E+00	4.3452E-01	1.3246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9068390	0.9672900	0.9760300	0.9978250	1.0000000	3.2555E+01	1.1009E+00
α_2	7.91E-04	2.48E-02	1.62E-02	7.82E-02	0.00E+00	8.3366E-01	3.2822E+01
α_3	2.80E-07	7.94E-03	1.61E-03	3.77E-02	0.00E+00	2.6722E-01	3.3389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9130680	0.9636200	0.9695110	0.9939910	1.0000000	4.9136E+01	1.8551E+00
α_2	2.00E-03	2.41E-02	1.82E-02	6.63E-02	0.00E+00	1.2281E+00	4.9763E+01
α_3	8.95E-06	7.93E-03	2.95E-03	3.27E-02	0.00E+00	4.0431E-01	5.0587E+01
α_4	1.89E-08	4.37E-03	5.99E-04	2.19E-02	0.00E+00	2.2267E-01	5.0768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9318350	0.9655480	0.9685320	0.9890570	1.0000000	9.9161E+01	3.5382E+00
α_2	3.97E-03	2.06E-02	1.76E-02	4.76E-02	0.00E+00	2.1142E+00	1.0059E+02
α_3	4.65E-04	9.52E-03	6.58E-03	2.86E-02	0.00E+00	9.7738E-01	1.0172E+02
α_4	2.40E-06	3.65E-03	1.23E-03	1.55E-02	0.00E+00	3.7439E-01	1.0232E+02
α_5	5.81E-21	7.04E-04	3.98E-07	4.08E-03	0.00E+00	7.2277E-02	1.0263E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9351640	0.9655550	0.9680290	0.9874920	1.0000000	1.1994E+02	4.2787E+00
α_2	3.71E-03	1.80E-02	1.55E-02	4.10E-02	0.00E+00	2.2392E+00	1.2198E+02
α_3	6.48E-04	9.19E-03	6.73E-03	2.62E-02	0.00E+00	1.1418E+00	1.2308E+02
α_4	4.26E-05	4.77E-03	2.50E-03	1.72E-02	0.00E+00	5.9222E-01	1.2363E+02
α_5	7.48E-09	1.79E-03	2.43E-04	8.96E-03	0.00E+00	2.2220E-01	1.2400E+02
α_6	1.14E-18	6.70E-04	1.17E-06	3.91E-03	0.00E+00	8.3237E-02	1.2414E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	3.00	3.00	3.00	3.00	3.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.6.4.3 COMBINED HPCI AND RCIC AIR OPERATED VALVE FAIL TO CLOSE

System :	High pressure coolant injection Reactor core isolation
Component :	Air Operated Valve
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 1.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8522320	0.9628000	0.9843830	0.9999320	1.0000000	1.1246E+01	4.3452E-01
α_2	7.00E-05	3.72E-02	1.56E-02	1.48E-01	0.00E+00	4.3452E-01	1.1246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9010680	0.9652240	0.9744830	0.9976820	1.0000000	3.0555E+01	1.1009E+00
α_2	8.43E-04	2.63E-02	1.72E-02	8.30E-02	0.00E+00	8.3366E-01	3.0822E+01
α_3	2.98E-07	8.44E-03	1.71E-03	4.00E-02	0.00E+00	2.6722E-01	3.1389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9095820	0.9621340	0.9682530	0.9937390	1.0000000	4.7136E+01	1.8551E+00
α_2	2.09E-03	2.51E-02	1.89E-02	6.90E-02	0.00E+00	1.2281E+00	4.7763E+01
α_3	9.32E-06	8.25E-03	3.07E-03	3.41E-02	0.00E+00	4.0431E-01	4.8587E+01
α_4	1.97E-08	4.55E-03	6.24E-04	2.28E-02	0.00E+00	2.2267E-01	4.8768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9304990	0.9648630	0.9678980	0.9888360	1.0000000	9.7161E+01	3.5382E+00
α_2	4.05E-03	2.10E-02	1.79E-02	4.85E-02	0.00E+00	2.1142E+00	9.8585E+01
α_3	4.74E-04	9.71E-03	6.71E-03	2.92E-02	0.00E+00	9.7738E-01	9.9722E+01
α_4	2.45E-06	3.72E-03	1.25E-03	1.58E-02	0.00E+00	3.7439E-01	1.0032E+02
α_5	5.93E-21	7.18E-04	4.06E-07	4.16E-03	0.00E+00	7.2277E-02	1.0063E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9341160	0.9649920	0.9674990	0.9872840	1.0000000	1.1794E+02	4.2787E+00
α_2	3.77E-03	1.83E-02	1.58E-02	4.16E-02	0.00E+00	2.2392E+00	1.1998E+02
α_3	6.58E-04	9.34E-03	6.84E-03	2.66E-02	0.00E+00	1.1418E+00	1.2108E+02
α_4	4.33E-05	4.85E-03	2.54E-03	1.75E-02	0.00E+00	5.9222E-01	1.2163E+02
α_5	7.60E-09	1.82E-03	2.47E-04	9.11E-03	0.00E+00	2.2220E-01	1.2200E+02
α_6	1.15E-18	6.81E-04	1.19E-06	3.98E-03	0.00E+00	8.3237E-02	1.2214E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

COMBINED HPCI AND RCIC AIR OPERATED VALVE FAIL TO CLOSE

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	1.00	1.00	1.00	1.00	1.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.7 Check Valves

1.7.1 Pooled Check Valves

1.7.1.1 CHECK VALVE FAIL TO OPEN ALL SYSTEMS SPAR: CKV-CC

Component :	Check Valve
Failure Mode :	Fail to open on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 9.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9116630	0.9779210	0.9909360	0.9999560	1.0000000	1.9246E+01	4.3452E-01
α_2	4.05E-05	2.21E-02	9.06E-03	8.83E-02	0.00E+00	4.3452E-01	1.9246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9207320	0.9722390	0.9797180	0.9981670	1.0000000	3.8555E+01	1.1009E+00
α_2	6.69E-04	2.10E-02	1.37E-02	6.65E-02	0.00E+00	8.3366E-01	3.8822E+01
α_3	2.37E-07	6.74E-03	1.36E-03	3.20E-02	0.00E+00	2.6722E-01	3.9389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9220800	0.9674500	0.9727570	0.9946390	1.0000000	5.5136E+01	1.8551E+00
α_2	1.79E-03	2.15E-02	1.63E-02	5.94E-02	0.00E+00	1.2281E+00	5.5763E+01
α_3	8.00E-06	7.09E-03	2.63E-03	2.93E-02	0.00E+00	4.0431E-01	5.6587E+01
α_4	1.69E-08	3.91E-03	5.36E-04	1.96E-02	0.00E+00	2.2267E-01	5.6768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9355510	0.9674490	0.9702750	0.9896710	1.0000000	1.0516E+02	3.5382E+00
α_2	3.75E-03	1.95E-02	1.66E-02	4.50E-02	0.00E+00	2.1142E+00	1.0658E+02
α_3	4.39E-04	8.99E-03	6.21E-03	2.70E-02	0.00E+00	9.7738E-01	1.0772E+02
α_4	2.26E-06	3.44E-03	1.16E-03	1.46E-02	0.00E+00	3.7439E-01	1.0832E+02
α_5	5.49E-21	6.65E-04	3.76E-07	3.85E-03	0.00E+00	7.2277E-02	1.0863E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9381170	0.9671430	0.9695070	0.9880770	1.0000000	1.2594E+02	4.2787E+00
α_2	3.53E-03	1.72E-02	1.48E-02	3.91E-02	0.00E+00	2.2392E+00	1.2798E+02
α_3	6.17E-04	8.77E-03	6.41E-03	2.50E-02	0.00E+00	1.1418E+00	1.2908E+02
α_4	4.07E-05	4.55E-03	2.38E-03	1.64E-02	0.00E+00	5.9222E-01	1.2963E+02
α_5	7.13E-09	1.71E-03	2.31E-04	8.55E-03	0.00E+00	2.2220E-01	1.3000E+02
α_6	1.08E-18	6.39E-04	1.12E-06	3.73E-03	0.00E+00	8.3237E-02	1.3014E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9448370	0.9676930	0.9692440	0.9852520	1.0000000	1.9305E+02	6.4450E+00
α_2	4.36E-03	1.55E-02	1.39E-02	3.20E-02	0.00E+00	3.0878E+00	1.9641E+02
α_3	1.10E-03	8.18E-03	6.60E-03	2.06E-02	0.00E+00	1.6312E+00	1.9786E+02
α_4	2.48E-04	4.96E-03	3.43E-03	1.49E-02	0.00E+00	9.8887E-01	1.9851E+02
α_5	1.29E-05	2.62E-03	1.24E-03	9.88E-03	0.00E+00	5.2177E-01	1.9897E+02
α_6	3.37E-10	9.34E-04	7.97E-05	4.90E-03	0.00E+00	1.8628E-01	1.9931E+02
α_7	0.00E+00	1.46E-04	1.28E-13	5.49E-04	0.00E+00	2.9071E-02	1.9947E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9475310	0.9682770	0.9695950	0.9845210	1.0000000	2.2773E+02	7.4610E+00
α_2	4.28E-03	1.42E-02	1.29E-02	2.88E-02	0.00E+00	3.3447E+00	2.3185E+02
α_3	1.09E-03	7.39E-03	6.05E-03	1.83E-02	0.00E+00	1.7384E+00	2.3345E+02
α_4	3.45E-04	4.87E-03	3.56E-03	1.39E-02	0.00E+00	1.1465E+00	2.3404E+02
α_5	5.48E-05	3.01E-03	1.77E-03	1.02E-02	0.00E+00	7.0833E-01	2.3448E+02
α_6	8.83E-07	1.56E-03	5.11E-04	6.67E-03	0.00E+00	3.6696E-01	2.3482E+02
α_7	6.92E-14	5.23E-04	9.40E-06	2.98E-03	0.00E+00	1.2297E-01	2.3507E+02
α_8	1.30E-42	1.41E-04	2.01E-12	5.95E-04	0.00E+00	3.3124E-02	2.3516E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	9.00	9.00	9.00	9.00	9.00	9.00	9.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.7.1.2 CHECK VALVE FAIL TO CLOSE ALL SYSTEMS SPAR:CKV-OO

Component : Check Valve
Failure Mode : Fail to close (reseat) on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 40.00
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8751220	0.9515160	0.9612810	0.9944480	0.9471560	2.8349E+01	1.4445E+00
α_2	5.55E-03	4.85E-02	3.87E-02	1.25E-01	5.28E-02	1.4445E+00	2.8349E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9170950	0.9637760	0.9689130	0.9928860	0.9634370	5.6680E+01	2.1303E+00
α_2	2.35E-03	2.32E-02	1.80E-02	6.16E-02	1.88E-02	1.3628E+00	5.7448E+01
α_3	3.17E-04	1.31E-02	8.09E-03	4.27E-02	1.78E-02	7.6752E-01	5.8043E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9285890	0.9658040	0.9693870	0.9907490	0.9715570	8.2265E+01	2.9128E+00
α_2	2.22E-03	1.80E-02	1.44E-02	4.62E-02	8.24E-03	1.5347E+00	8.3643E+01
α_3	4.24E-04	1.06E-02	7.12E-03	3.28E-02	1.35E-02	9.0541E-01	8.4272E+01
α_4	1.62E-05	5.55E-03	2.42E-03	2.17E-02	6.72E-03	4.7267E-01	8.4705E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9413710	0.9682490	0.9703650	0.9878890	0.9763140	1.4127E+02	4.6326E+00
α_2	3.43E-03	1.60E-02	1.38E-02	3.59E-02	4.68E-03	2.3306E+00	1.4357E+02
α_3	9.20E-04	9.29E-03	7.16E-03	2.49E-02	8.18E-03	1.3553E+00	1.4455E+02
α_4	1.14E-04	5.14E-03	3.12E-03	1.70E-02	8.12E-03	7.4939E-01	1.4515E+02
α_5	1.14E-09	1.35E-03	1.36E-04	7.00E-03	2.71E-03	1.9728E-01	1.4571E+02

CHECK VALVE FAIL TO CLOSE ALL SYSTEMS SPAR:CKV-OO

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9454040	0.9692960	0.9710520	0.9871820	0.9793790	1.7102E+02	5.4173E+00
α_2	3.10E-03	1.38E-02	1.20E-02	3.06E-02	3.54E-03	2.4346E+00	1.7400E+02
α_3	8.28E-04	7.92E-03	6.15E-03	2.10E-02	4.63E-03	1.3975E+00	1.7504E+02
α_4	2.60E-04	5.48E-03	3.76E-03	1.66E-02	6.79E-03	9.6722E-01	1.7547E+02
α_5	7.74E-06	2.68E-03	1.16E-03	1.05E-02	4.53E-03	4.7220E-01	1.7597E+02
α_6	4.22E-12	8.26E-04	3.09E-05	4.58E-03	1.13E-03	1.4574E-01	1.7629E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9506410	0.9700240	0.9712450	0.9852310	0.9814670	2.4708E+02	7.6352E+00
α_2	3.85E-03	1.30E-02	1.17E-02	2.63E-02	3.29E-03	3.2991E+00	2.5142E+02
α_3	1.09E-03	7.06E-03	5.82E-03	1.73E-02	2.59E-03	1.7975E+00	2.5292E+02
α_4	4.68E-04	5.11E-03	3.89E-03	1.39E-02	4.87E-03	1.3014E+00	2.5341E+02
α_5	1.02E-04	3.28E-03	2.10E-03	1.04E-02	4.87E-03	8.3427E-01	2.5388E+02
α_6	4.49E-07	1.34E-03	4.02E-04	5.89E-03	2.43E-03	3.4258E-01	2.5437E+02
α_7	6.52E-25	2.37E-04	2.39E-08	1.33E-03	4.87E-04	6.0371E-02	2.5465E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9534200	0.9709480	0.9719890	0.9849140	0.9831000	2.9071E+02	8.6984E+00
α_2	3.78E-03	1.19E-02	1.09E-02	2.38E-02	3.17E-03	3.5771E+00	2.9583E+02
α_3	9.99E-04	6.19E-03	5.13E-03	1.50E-02	1.55E-03	1.8521E+00	2.9756E+02
α_4	4.71E-04	4.61E-03	3.57E-03	1.23E-02	3.21E-03	1.3815E+00	2.9803E+02
α_5	1.85E-04	3.41E-03	2.39E-03	1.01E-02	4.27E-03	1.0208E+00	2.9839E+02
α_6	1.91E-05	2.01E-03	1.06E-03	7.21E-03	3.20E-03	6.0136E-01	2.9881E+02
α_7	2.20E-09	7.24E-04	9.23E-05	3.65E-03	1.28E-03	2.1677E-01	2.9919E+02
α_8	3.88E-30	1.63E-04	1.30E-09	8.58E-04	2.13E-04	4.8724E-02	2.9936E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9471560	0.9634370	0.9715570	0.9763140	0.9793790	0.9814670	0.9831000
α_2	5.28E-02	1.88E-02	8.24E-03	4.68E-03	3.54E-03	3.29E-03	3.17E-03
α_3		1.78E-02	1.35E-02	8.18E-03	4.63E-03	2.59E-03	1.55E-03
α_4			6.72E-03	8.12E-03	6.79E-03	4.87E-03	3.21E-03
α_5				2.71E-03	4.53E-03	4.87E-03	4.27E-03
α_6					1.13E-03	2.43E-03	3.20E-03
α_7						4.87E-04	1.28E-03
α_8							2.13E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.47E-01	9.63E-01	9.72E-01	9.76E-01	9.79E-01	9.81E-01	9.83E-01
Beta	5.28E-02	3.66E-02	2.84E-02	2.37E-02	2.06E-02	1.85E-02	1.69E-02
Gamma		4.86E-01	7.10E-01	8.02E-01	8.28E-01	8.22E-01	8.12E-01
Delta			3.33E-01	5.70E-01	7.29E-01	8.30E-01	8.87E-01
Epsilon				2.50E-01	4.55E-01	6.15E-01	7.36E-01
Mu					2.00E-01	3.75E-01	5.24E-01
Upsilon						1.67E-01	3.18E-01
Sigma							1.43E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	17.78	26.67	35.56	44.44	53.33	62.22	71.11
N_1	0.3229	0.4551	0.5691	0.6657	0.7457	0.8100	0.8717
N_2	1.0100	0.5291	0.3066	0.2164	0.1954	0.2113	0.2324
N_3		0.5003	0.5011	0.3779	0.2557	0.1663	0.1137
N_4			0.2500	0.3750	0.3750	0.3125	0.2350
N_5				0.1250	0.2500	0.3125	0.3125
N_6					0.0625	0.1563	0.2344
N_7						0.0313	0.0938
N_8							0.0156

1.7.1.3 CHECK VALVE FAIL TO REMAIN CLOSED ALL SYSTEMS SPAR:CKV-CO

Component : Check Valve
Failure Mode : Spurious operation open or close
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 0.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8386830	0.9593170	0.9828300	0.9999250	1.0000000	1.0246E+01	4.3452E-01
α_2	7.70E-05	4.07E-02	1.72E-02	1.61E-01	0.00E+00	4.3452E-01	1.0246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8979020	0.9640890	0.9736330	0.9976040	1.0000000	2.9555E+01	1.1009E+00
α_2	8.71E-04	2.72E-02	1.78E-02	8.57E-02	0.00E+00	8.3366E-01	2.9822E+01
α_3	3.08E-07	8.72E-03	1.77E-03	4.13E-02	0.00E+00	2.6722E-01	3.0389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9077330	0.9613450	0.9675780	0.9936050	1.0000000	4.6136E+01	1.8551E+00
α_2	2.13E-03	2.56E-02	1.93E-02	7.04E-02	0.00E+00	1.2281E+00	4.6763E+01
α_3	9.52E-06	8.42E-03	3.13E-03	3.48E-02	0.00E+00	4.0431E-01	4.7587E+01
α_4	2.01E-08	4.64E-03	6.37E-04	2.32E-02	0.00E+00	2.2267E-01	4.7768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9298110	0.9645110	0.9675740	0.9887220	1.0000000	9.6161E+01	3.5382E+00
α_2	4.09E-03	2.12E-02	1.81E-02	4.90E-02	0.00E+00	2.1142E+00	9.7585E+01
α_3	4.79E-04	9.80E-03	6.78E-03	2.95E-02	0.00E+00	9.7738E-01	9.8722E+01
α_4	2.47E-06	3.76E-03	1.27E-03	1.59E-02	0.00E+00	3.7439E-01	9.9325E+01
α_5	5.99E-21	7.25E-04	4.10E-07	4.20E-03	0.00E+00	7.2277E-02	9.9627E+01

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9335790	0.9647030	0.9672350	0.9871780	1.0000000	1.1694E+02	4.2787E+00
α_2	3.80E-03	1.85E-02	1.59E-02	4.20E-02	0.00E+00	2.2392E+00	1.1898E+02
α_3	6.64E-04	9.42E-03	6.89E-03	2.68E-02	0.00E+00	1.1418E+00	1.2008E+02
α_4	4.37E-05	4.89E-03	2.56E-03	1.76E-02	0.00E+00	5.9222E-01	1.2063E+02
α_5	7.67E-09	1.83E-03	2.49E-04	9.18E-03	0.00E+00	2.2220E-01	1.2100E+02
α_6	1.16E-18	6.87E-04	1.20E-06	4.01E-03	0.00E+00	8.3237E-02	1.2114E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9422570	0.9661670	0.9677850	0.9845420	1.0000000	1.8405E+02	6.4450E+00
α_2	4.57E-03	1.62E-02	1.45E-02	3.35E-02	0.00E+00	3.0878E+00	1.8741E+02
α_3	1.15E-03	8.56E-03	6.91E-03	2.16E-02	0.00E+00	1.6312E+00	1.8886E+02
α_4	2.60E-04	5.19E-03	3.59E-03	1.56E-02	0.00E+00	9.8887E-01	1.8951E+02
α_5	1.35E-05	2.74E-03	1.30E-03	1.04E-02	0.00E+00	5.2177E-01	1.8997E+02
α_6	3.53E-10	9.78E-04	8.35E-05	5.13E-03	0.00E+00	1.8628E-01	1.9031E+02
α_7	0.00E+00	1.53E-04	1.34E-13	5.75E-04	0.00E+00	2.9071E-02	1.9047E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9454620	0.9670150	0.9683850	0.9838980	1.0000000	2.1873E+02	7.4610E+00
α_2	4.45E-03	1.48E-02	1.34E-02	2.99E-02	0.00E+00	3.3447E+00	2.2285E+02
α_3	1.14E-03	7.69E-03	6.29E-03	1.90E-02	0.00E+00	1.7384E+00	2.2445E+02
α_4	3.59E-04	5.07E-03	3.71E-03	1.44E-02	0.00E+00	1.1465E+00	2.2504E+02
α_5	5.70E-05	3.13E-03	1.84E-03	1.06E-02	0.00E+00	7.0833E-01	2.2548E+02
α_6	9.18E-07	1.62E-03	5.31E-04	6.94E-03	0.00E+00	3.6696E-01	2.2582E+02
α_7	7.20E-14	5.44E-04	9.78E-06	3.10E-03	0.00E+00	1.2297E-01	2.2607E+02
α_8	1.35E-42	1.46E-04	2.09E-12	6.19E-04	0.00E+00	3.3124E-02	2.2616E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.7.1.4 CKV FAIL TO REMAIN CLOSED (LEAKAGE) ALL SYSTEMS SPAR:CKV-CO

Component : Check Valve
Failure Mode : Fail to remain closed(detectable leakage)
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 48.10
Total Number of Common-Cause Failure Events: 7

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.7966510	0.8897680	0.8966490	0.9593110	0.8623000	3.3565E+01	4.1583E+00
α_2	4.07E-02	1.10E-01	1.03E-01	2.03E-01	1.38E-01	4.1583E+00	3.3565E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8547690	0.9155600	0.9195700	0.9626360	0.8766280	6.3053E+01	5.8152E+00
α_2	1.47E-02	4.82E-02	4.39E-02	9.65E-02	6.50E-02	3.3194E+00	6.5549E+01
α_3	8.47E-03	3.62E-02	3.18E-02	7.91E-02	5.83E-02	2.4958E+00	6.6372E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8728020	0.9218370	0.9247270	0.9609890	0.8831690	8.9441E+01	7.5837E+00
α_2	1.29E-02	3.87E-02	3.56E-02	7.53E-02	5.16E-02	3.7567E+00	9.3268E+01
α_3	6.15E-03	2.61E-02	2.29E-02	5.70E-02	4.34E-02	2.5329E+00	9.4492E+01
α_4	1.22E-03	1.33E-02	1.02E-02	3.63E-02	2.19E-02	1.2941E+00	9.5731E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9013180	0.9359490	0.9377710	0.9643600	0.8881990	1.4912E+02	1.0205E+01
α_2	1.14E-02	2.96E-02	2.76E-02	5.44E-02	4.35E-02	4.7094E+00	1.5462E+02
α_3	5.23E-03	1.89E-02	1.69E-02	3.94E-02	3.41E-02	3.0131E+00	1.5631E+02
α_4	1.98E-03	1.19E-02	9.90E-03	2.85E-02	2.55E-02	1.8923E+00	1.5743E+02
α_5	3.26E-05	3.70E-03	1.93E-03	1.34E-02	8.69E-03	5.9018E-01	1.5873E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9107480	0.9410640	0.9426000	0.9661420	0.9002150	1.8009E+02	1.1279E+01
α_2	7.56E-03	2.15E-02	1.99E-02	4.11E-02	2.67E-02	4.1142E+00	1.8725E+02
α_3	5.35E-03	1.76E-02	1.60E-02	3.56E-02	3.18E-02	3.3739E+00	1.8799E+02
α_4	2.43E-03	1.18E-02	1.01E-02	2.68E-02	2.37E-02	2.2529E+00	1.8912E+02
α_5	4.95E-04	6.29E-03	4.68E-03	1.76E-02	1.40E-02	1.2043E+00	1.9016E+02
α_6	4.66E-07	1.74E-03	5.00E-04	7.69E-03	3.56E-03	3.3324E-01	1.9104E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9270460	0.9504190	0.9515260	0.9700210	0.9132370	2.5773E+02	1.3445E+01
α_2	6.20E-03	1.66E-02	1.55E-02	3.11E-02	1.77E-02	4.5128E+00	2.6666E+02
α_3	3.38E-03	1.17E-02	1.06E-02	2.41E-02	1.92E-02	3.1812E+00	2.6799E+02
α_4	2.94E-03	1.09E-02	9.71E-03	2.29E-02	2.43E-02	2.9514E+00	2.6822E+02
α_5	1.17E-03	6.99E-03	5.83E-03	1.68E-02	1.70E-02	1.8968E+00	2.6928E+02
α_6	6.10E-05	2.76E-03	1.67E-03	9.16E-03	6.97E-03	7.4878E-01	2.7043E+02
α_7	8.39E-12	5.68E-04	2.61E-05	3.11E-03	1.55E-03	1.5407E-01	2.7102E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9337240	0.9544380	0.9553870	0.9719000	0.9232460	3.0293E+02	1.4461E+01
α_2	5.15E-03	1.40E-02	1.30E-02	2.63E-02	1.20E-02	4.4378E+00	3.1295E+02
α_3	2.69E-03	9.64E-03	8.63E-03	2.00E-02	1.45E-02	3.0590E+00	3.1433E+02
α_4	1.71E-03	7.66E-03	6.66E-03	1.71E-02	1.41E-02	2.4321E+00	3.1496E+02
α_5	2.30E-03	8.89E-03	7.88E-03	1.89E-02	2.32E-02	2.8214E+00	3.1457E+02
α_6	2.57E-04	3.62E-03	2.64E-03	1.03E-02	8.57E-03	1.1483E+00	3.1624E+02
α_7	3.98E-06	1.47E-03	6.29E-04	5.79E-03	3.77E-03	4.6677E-01	3.1692E+02
α_8	4.74E-17	3.01E-04	1.36E-06	1.75E-03	6.85E-04	9.5624E-02	3.1730E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.8623000	0.8766280	0.8831690	0.8881990	0.9002150	0.9132370	0.9232460
α_2	1.38E-01	6.50E-02	5.16E-02	4.35E-02	2.67E-02	1.77E-02	1.20E-02
α_3		5.83E-02	4.34E-02	3.41E-02	3.18E-02	1.92E-02	1.45E-02
α_4			2.19E-02	2.55E-02	2.37E-02	2.43E-02	1.41E-02
α_5				8.69E-03	1.40E-02	1.70E-02	2.32E-02
α_6					3.56E-03	6.97E-03	8.57E-03
α_7						1.55E-03	3.77E-03
α_8							6.85E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	8.62E-01	8.77E-01	8.83E-01	8.88E-01	9.00E-01	9.13E-01	9.23E-01
Beta	1.38E-01	1.23E-01	1.17E-01	1.12E-01	9.98E-02	8.68E-02	7.68E-02
Gamma		4.73E-01	5.59E-01	6.11E-01	7.32E-01	7.96E-01	8.44E-01
Delta			3.35E-01	5.00E-01	5.64E-01	7.22E-01	7.76E-01
Epsilon				2.54E-01	4.26E-01	5.12E-01	7.20E-01
Mu					2.03E-01	3.33E-01	3.60E-01
Upsilon						1.82E-01	3.42E-01
Sigma							1.54E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	21.05	31.58	42.10	52.63	63.15	73.68	84.20
N_1	2.2690	1.9179	1.2048	0.3333	0.0000	0.0000	0.0000
N_2	3.7238	2.4857	2.5286	2.5952	1.8750	1.4250	1.0931
N_3		2.2286	2.1286	2.0357	2.2321	1.5500	1.3206
N_4			1.0714	1.5179	1.6607	1.9625	1.2856
N_5				0.5179	0.9821	1.3750	2.1131
N_6					0.2500	0.5625	0.7813
N_7						0.1250	0.3438
N_8							0.0625

1.7.2 BWR Residual Heat Removal Check Valves

1.7.2.1 BWR RHR CHECK VALVE FAIL TO OPEN

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Check Valve
Failure Mode :	Fail to open on demand
Plant Type :	BWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 2.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8636860	0.9657330	0.9856730	0.9999380	1.0000000	1.2246E+01	4.3452E-01
α_2	6.41E-05	3.43E-02	1.43E-02	1.36E-01	0.00E+00	4.3452E-01	1.2246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9040420	0.9662880	0.9752810	0.9977560	1.0000000	3.1555E+01	1.1009E+00
α_2	8.16E-04	2.55E-02	1.67E-02	8.05E-02	0.00E+00	8.3366E-01	3.1822E+01
α_3	2.88E-07	8.18E-03	1.66E-03	3.88E-02	0.00E+00	2.6722E-01	3.2389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9113590	0.9628920	0.9688970	0.9938680	1.0000000	4.8136E+01	1.8551E+00
α_2	2.04E-03	2.46E-02	1.86E-02	6.77E-02	0.00E+00	1.2281E+00	4.8763E+01
α_3	9.14E-06	8.09E-03	3.01E-03	3.34E-02	0.00E+00	4.0431E-01	4.9587E+01
α_4	1.93E-08	4.45E-03	6.12E-04	2.23E-02	0.00E+00	2.2267E-01	4.9768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9311740	0.9652090	0.9682200	0.9889480	1.0000000	9.8161E+01	3.5382E+00
α_2	4.01E-03	2.08E-02	1.77E-02	4.80E-02	0.00E+00	2.1142E+00	9.9585E+01
α_3	4.70E-04	9.61E-03	6.64E-03	2.89E-02	0.00E+00	9.7738E-01	1.0072E+02
α_4	2.42E-06	3.68E-03	1.24E-03	1.56E-02	0.00E+00	3.7439E-01	1.0132E+02
α_5	5.87E-21	7.11E-04	4.02E-07	4.12E-03	0.00E+00	7.2277E-02	1.0163E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9346440	0.9652760	0.9677640	0.9873890	1.0000000	1.1894E+02	4.2787E+00
α_2	3.74E-03	1.82E-02	1.56E-02	4.13E-02	0.00E+00	2.2392E+00	1.2098E+02
α_3	6.53E-04	9.27E-03	6.78E-03	2.64E-02	0.00E+00	1.1418E+00	1.2208E+02
α_4	4.30E-05	4.81E-03	2.52E-03	1.73E-02	0.00E+00	5.9222E-01	1.2263E+02
α_5	7.54E-09	1.80E-03	2.45E-04	9.04E-03	0.00E+00	2.2220E-01	1.2300E+02
α_6	1.14E-18	6.76E-04	1.18E-06	3.94E-03	0.00E+00	8.3237E-02	1.2314E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9428470	0.9665190	0.9681250	0.9847050	1.0000000	1.8605E+02	6.4450E+00
α_2	4.52E-03	1.60E-02	1.44E-02	3.32E-02	0.00E+00	3.0878E+00	1.8941E+02
α_3	1.14E-03	8.47E-03	6.84E-03	2.14E-02	0.00E+00	1.6312E+00	1.9086E+02
α_4	2.57E-04	5.14E-03	3.56E-03	1.54E-02	0.00E+00	9.8887E-01	1.9151E+02
α_5	1.33E-05	2.71E-03	1.28E-03	1.02E-02	0.00E+00	5.2177E-01	1.9197E+02
α_6	3.49E-10	9.68E-04	8.26E-05	5.08E-03	0.00E+00	1.8628E-01	1.9231E+02
α_7	0.00E+00	1.51E-04	1.32E-13	5.69E-04	0.00E+00	2.9071E-02	1.9247E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9459360	0.9673040	0.9686640	0.9840410	1.0000000	2.2073E+02	7.4610E+00
α_2	4.41E-03	1.47E-02	1.33E-02	2.97E-02	0.00E+00	3.3447E+00	2.2485E+02
α_3	1.13E-03	7.62E-03	6.24E-03	1.88E-02	0.00E+00	1.7384E+00	2.2645E+02
α_4	3.56E-04	5.02E-03	3.67E-03	1.43E-02	0.00E+00	1.1465E+00	2.2704E+02
α_5	5.65E-05	3.10E-03	1.82E-03	1.05E-02	0.00E+00	7.0833E-01	2.2748E+02
α_6	9.10E-07	1.61E-03	5.27E-04	6.88E-03	0.00E+00	3.6696E-01	2.2782E+02
α_7	7.14E-14	5.39E-04	9.69E-06	3.07E-03	0.00E+00	1.2297E-01	2.2807E+02
α_8	1.34E-42	1.45E-04	2.07E-12	6.14E-04	0.00E+00	3.3124E-02	2.2816E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	2.00	2.00	2.00	2.00	2.00	2.00	2.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.7.2.2 BWR RHR CHECK VALVE FAIL TO CLOSE

System : Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component : Check Valve
Failure Mode : Fail to close (reseat) on demand
Plant Type : BWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 6.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8959650	0.9739500	0.9892430	0.9999480	1.0000000	1.6246E+01	4.3452E-01
α_2	4.81E-05	2.60E-02	1.08E-02	1.04E-01	0.00E+00	4.3452E-01	1.6246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9143470	0.9699670	0.9780280	0.9980130	1.0000000	3.5555E+01	1.1009E+00
α_2	7.25E-04	2.27E-02	1.48E-02	7.18E-02	0.00E+00	8.3366E-01	3.5822E+01
α_3	2.56E-07	7.29E-03	1.48E-03	3.46E-02	0.00E+00	2.6722E-01	3.6389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9178250	0.9656410	0.9712250	0.9943340	1.0000000	5.2136E+01	1.8551E+00
α_2	1.89E-03	2.27E-02	1.72E-02	6.27E-02	0.00E+00	1.2281E+00	5.2763E+01
α_3	8.45E-06	7.49E-03	2.78E-03	3.09E-02	0.00E+00	4.0431E-01	5.3587E+01
α_4	1.78E-08	4.12E-03	5.66E-04	2.07E-02	0.00E+00	2.2267E-01	5.3768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9337450	0.9665250	0.9694270	0.9893730	1.0000000	1.0216E+02	3.5382E+00
α_2	3.85E-03	2.00E-02	1.71E-02	4.62E-02	0.00E+00	2.1142E+00	1.0358E+02
α_3	4.52E-04	9.25E-03	6.39E-03	2.78E-02	0.00E+00	9.7738E-01	1.0472E+02
α_4	2.33E-06	3.54E-03	1.19E-03	1.50E-02	0.00E+00	3.7439E-01	1.0532E+02
α_5	5.65E-21	6.84E-04	3.87E-07	3.96E-03	0.00E+00	7.2277E-02	1.0563E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9366750	0.9663680	0.9687880	0.9877920	1.0000000	1.2294E+02	4.2787E+00
α_2	3.62E-03	1.76E-02	1.51E-02	4.00E-02	0.00E+00	2.2392E+00	1.2498E+02
α_3	6.32E-04	8.98E-03	6.57E-03	2.55E-02	0.00E+00	1.1418E+00	1.2608E+02
α_4	4.16E-05	4.66E-03	2.44E-03	1.68E-02	0.00E+00	5.9222E-01	1.2663E+02
α_5	7.30E-09	1.75E-03	2.37E-04	8.75E-03	0.00E+00	2.2220E-01	1.2700E+02
α_6	1.11E-18	6.54E-04	1.14E-06	3.82E-03	0.00E+00	8.3237E-02	1.2714E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9439980	0.9672000	0.9687770	0.9850250	1.0000000	1.9005E+02	6.4450E+00
α_2	4.43E-03	1.57E-02	1.41E-02	3.25E-02	0.00E+00	3.0878E+00	1.9341E+02
α_3	1.12E-03	8.30E-03	6.70E-03	2.10E-02	0.00E+00	1.6312E+00	1.9486E+02
α_4	2.52E-04	5.03E-03	3.48E-03	1.51E-02	0.00E+00	9.8887E-01	1.9551E+02
α_5	1.31E-05	2.66E-03	1.26E-03	1.00E-02	0.00E+00	5.2177E-01	1.9597E+02
α_6	3.42E-10	9.48E-04	8.09E-05	4.98E-03	0.00E+00	1.8628E-01	1.9631E+02
α_7	0.00E+00	1.48E-04	1.30E-13	5.57E-04	0.00E+00	2.9071E-02	1.9647E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9468590	0.9678670	0.9692050	0.9843190	1.0000000	2.2473E+02	7.4610E+00
α_2	4.33E-03	1.44E-02	1.30E-02	2.92E-02	0.00E+00	3.3447E+00	2.2885E+02
α_3	1.11E-03	7.49E-03	6.13E-03	1.85E-02	0.00E+00	1.7384E+00	2.3045E+02
α_4	3.50E-04	4.94E-03	3.61E-03	1.41E-02	0.00E+00	1.1465E+00	2.3104E+02
α_5	5.55E-05	3.05E-03	1.79E-03	1.03E-02	0.00E+00	7.0833E-01	2.3148E+02
α_6	8.95E-07	1.58E-03	5.17E-04	6.76E-03	0.00E+00	3.6696E-01	2.3182E+02
α_7	7.01E-14	5.30E-04	9.53E-06	3.02E-03	0.00E+00	1.2297E-01	2.3207E+02
α_8	1.31E-42	1.43E-04	2.03E-12	6.03E-04	0.00E+00	3.3124E-02	2.3216E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	6.00	6.00	6.00	6.00	6.00	6.00	6.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.7.3 PWR Auxiliary Feedwater Check Valves

1.7.3.1 CHECK VALVE FAIL TO OPEN SPAR: AFW-CKV-CC

System : Auxiliary feedwater
Component : Check Valve
Failure Mode : Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 2.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8636860	0.9657330	0.9856730	0.9999380	1.0000000	1.2246E+01	4.3452E-01
α_2	6.41E-05	3.43E-02	1.43E-02	1.36E-01	0.00E+00	4.3452E-01	1.2246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9040420	0.9662880	0.9752810	0.9977560	1.0000000	3.1555E+01	1.1009E+00
α_2	8.16E-04	2.55E-02	1.67E-02	8.05E-02	0.00E+00	8.3366E-01	3.1822E+01
α_3	2.88E-07	8.18E-03	1.66E-03	3.88E-02	0.00E+00	2.6722E-01	3.2389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9113590	0.9628920	0.9688970	0.9938680	1.0000000	4.8136E+01	1.8551E+00
α_2	2.04E-03	2.46E-02	1.86E-02	6.77E-02	0.00E+00	1.2281E+00	4.8763E+01
α_3	9.14E-06	8.09E-03	3.01E-03	3.34E-02	0.00E+00	4.0431E-01	4.9587E+01
α_4	1.93E-08	4.45E-03	6.12E-04	2.23E-02	0.00E+00	2.2267E-01	4.9768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9311740	0.9652090	0.9682200	0.9889480	1.0000000	9.8161E+01	3.5382E+00
α_2	4.01E-03	2.08E-02	1.77E-02	4.80E-02	0.00E+00	2.1142E+00	9.9585E+01
α_3	4.70E-04	9.61E-03	6.64E-03	2.89E-02	0.00E+00	9.7738E-01	1.0072E+02
α_4	2.42E-06	3.68E-03	1.24E-03	1.56E-02	0.00E+00	3.7439E-01	1.0132E+02
α_5	5.87E-21	7.11E-04	4.02E-07	4.12E-03	0.00E+00	7.2277E-02	1.0163E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9346440	0.9652760	0.9677640	0.9873890	1.0000000	1.1894E+02	4.2787E+00
α_2	3.74E-03	1.82E-02	1.56E-02	4.13E-02	0.00E+00	2.2392E+00	1.2098E+02
α_3	6.53E-04	9.27E-03	6.78E-03	2.64E-02	0.00E+00	1.1418E+00	1.2208E+02
α_4	4.30E-05	4.81E-03	2.52E-03	1.73E-02	0.00E+00	5.9222E-01	1.2263E+02
α_5	7.54E-09	1.80E-03	2.45E-04	9.04E-03	0.00E+00	2.2220E-01	1.2300E+02
α_6	1.14E-18	6.76E-04	1.18E-06	3.94E-03	0.00E+00	8.3237E-02	1.2314E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9428470	0.9665190	0.9681250	0.9847050	1.0000000	1.8605E+02	6.4450E+00
α_2	4.52E-03	1.60E-02	1.44E-02	3.32E-02	0.00E+00	3.0878E+00	1.8941E+02
α_3	1.14E-03	8.47E-03	6.84E-03	2.14E-02	0.00E+00	1.6312E+00	1.9086E+02
α_4	2.57E-04	5.14E-03	3.56E-03	1.54E-02	0.00E+00	9.8887E-01	1.9151E+02
α_5	1.33E-05	2.71E-03	1.28E-03	1.02E-02	0.00E+00	5.2177E-01	1.9197E+02
α_6	3.49E-10	9.68E-04	8.26E-05	5.08E-03	0.00E+00	1.8628E-01	1.9231E+02
α_7	0.00E+00	1.51E-04	1.32E-13	5.69E-04	0.00E+00	2.9071E-02	1.9247E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9459360	0.9673040	0.9686640	0.9840410	1.0000000	2.2073E+02	7.4610E+00
α_2	4.41E-03	1.47E-02	1.33E-02	2.97E-02	0.00E+00	3.3447E+00	2.2485E+02
α_3	1.13E-03	7.62E-03	6.24E-03	1.88E-02	0.00E+00	1.7384E+00	2.2645E+02
α_4	3.56E-04	5.02E-03	3.67E-03	1.43E-02	0.00E+00	1.1465E+00	2.2704E+02
α_5	5.65E-05	3.10E-03	1.82E-03	1.05E-02	0.00E+00	7.0833E-01	2.2748E+02
α_6	9.10E-07	1.61E-03	5.27E-04	6.88E-03	0.00E+00	3.6696E-01	2.2782E+02
α_7	7.14E-14	5.39E-04	9.69E-06	3.07E-03	0.00E+00	1.2297E-01	2.2807E+02
α_8	1.34E-42	1.45E-04	2.07E-12	6.14E-04	0.00E+00	3.3124E-02	2.2816E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	2.00	2.00	2.00	2.00	2.00	2.00	2.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.7.3.2 CHECK VALVE FAIL TO CLOSE SPAR: AFW-CKV-OO

System :	Auxiliary feedwater
Component :	Check Valve
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 6.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8622100	0.9650630	0.9850520	0.9999270	0.9951050	1.2279E+01	4.4452E-01
α_2	7.51E-05	3.49E-02	1.49E-02	1.38E-01	4.90E-03	4.4452E-01	1.2279E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9054200	0.9664710	0.9752020	0.9976340	0.9903750	3.2580E+01	1.1303E+00
α_2	9.06E-04	2.56E-02	1.70E-02	7.97E-02	9.53E-03	8.6276E-01	3.2848E+01
α_3	2.83E-07	7.94E-03	1.61E-03	3.76E-02	9.82E-05	2.6752E-01	3.3443E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9130430	0.9632500	0.9690280	0.9936780	0.9857770	5.0135E+01	1.9128E+00
α_2	2.24E-03	2.47E-02	1.89E-02	6.69E-02	1.40E-02	1.2847E+00	5.0763E+01
α_3	8.95E-06	7.79E-03	2.90E-03	3.21E-02	2.71E-04	4.0541E-01	5.1642E+01
α_4	1.85E-08	4.28E-03	5.87E-04	2.14E-02	0.00E+00	2.2267E-01	5.1825E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9318790	0.9653230	0.9682480	0.9887640	0.9813270	1.0112E+02	3.6325E+00
α_2	4.26E-03	2.11E-02	1.81E-02	4.80E-02	1.81E-02	2.2056E+00	1.0255E+02
α_3	4.61E-04	9.36E-03	6.48E-03	2.81E-02	5.74E-04	9.8028E-01	1.0377E+02
α_4	2.35E-06	3.57E-03	1.20E-03	1.52E-02	0.00E+00	3.7439E-01	1.0438E+02
α_5	5.70E-21	6.90E-04	3.90E-07	4.00E-03	0.00E+00	7.2277E-02	1.0468E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9351890	0.9652860	0.9676960	0.9871310	0.9769930	1.2283E+02	4.4173E+00
α_2	4.09E-03	1.86E-02	1.62E-02	4.16E-02	2.21E-02	2.3721E+00	1.2488E+02
α_3	6.42E-04	9.02E-03	6.61E-03	2.56E-02	9.46E-04	1.1475E+00	1.2610E+02
α_4	4.16E-05	4.65E-03	2.44E-03	1.68E-02	0.00E+00	5.9222E-01	1.2666E+02
α_5	7.30E-09	1.75E-03	2.37E-04	8.75E-03	0.00E+00	2.2220E-01	1.2703E+02
α_6	1.11E-18	6.54E-04	1.14E-06	3.82E-03	0.00E+00	8.3237E-02	1.2716E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9430230	0.9664040	0.9679700	0.9844380	0.9728570	1.9086E+02	6.6350E+00
α_2	4.89E-03	1.65E-02	1.49E-02	3.37E-02	2.57E-02	3.2678E+00	1.9423E+02
α_3	1.13E-03	8.31E-03	6.72E-03	2.09E-02	1.43E-03	1.6412E+00	1.9585E+02
α_4	2.51E-04	5.01E-03	3.47E-03	1.50E-02	0.00E+00	9.8887E-01	1.9651E+02
α_5	1.30E-05	2.64E-03	1.25E-03	9.98E-03	0.00E+00	5.2177E-01	1.9697E+02
α_6	3.40E-10	9.43E-04	8.05E-05	4.95E-03	0.00E+00	1.8628E-01	1.9731E+02
α_7	0.00E+00	1.47E-04	1.29E-13	5.54E-04	0.00E+00	2.9071E-02	1.9747E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9460000	0.9671240	0.9684480	0.9837360	0.9702220	2.2646E+02	7.6983E+00
α_2	4.81E-03	1.52E-02	1.39E-02	3.03E-02	2.72E-02	3.5615E+00	2.3060E+02
α_3	1.13E-03	7.51E-03	6.16E-03	1.85E-02	2.50E-03	1.7583E+00	2.3240E+02
α_4	3.47E-04	4.90E-03	3.58E-03	1.40E-02	7.53E-05	1.1471E+00	2.3301E+02
α_5	5.51E-05	3.03E-03	1.78E-03	1.02E-02	0.00E+00	7.0833E-01	2.3345E+02
α_6	8.87E-07	1.57E-03	5.13E-04	6.70E-03	0.00E+00	3.6696E-01	2.3379E+02
α_7	6.95E-14	5.25E-04	9.44E-06	2.99E-03	0.00E+00	1.2297E-01	2.3404E+02
α_8	1.30E-42	1.41E-04	2.02E-12	5.98E-04	0.00E+00	3.3124E-02	2.3413E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9951050	0.9903750	0.9857770	0.9813270	0.9769930	0.9728570	0.9702220
α_2	4.90E-03	9.53E-03	1.40E-02	1.81E-02	2.21E-02	2.57E-02	2.72E-02
α_3		9.82E-05	2.71E-04	5.74E-04	9.46E-04	1.43E-03	2.50E-03
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.53E-05
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.95E-01	9.90E-01	9.86E-01	9.81E-01	9.77E-01	9.73E-01	9.70E-01
Beta	4.90E-03	9.63E-03	1.42E-02	1.87E-02	2.30E-02	2.71E-02	2.98E-02
Gamma		1.02E-02	1.91E-02	3.08E-02	4.11E-02	5.26E-02	8.64E-02
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.93E-02
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	1.71	2.57	3.43	4.29	5.14	6.00	6.86
N_1	0.3229	0.4551	0.5691	0.6657	0.7457	0.8100	0.8717
N_2	0.0100	0.0291	0.0566	0.0914	0.1329	0.1800	0.2168
N_3		0.0003	0.0011	0.0029	0.0057	0.0100	0.0199
N_4			0.0000	0.0000	0.0000	0.0000	0.0006
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.7.4 PWR High Pressure Safety Injection Check Valves

1.7.4.1 HIGH PRESSURE INJECTION CHECK VALVE FAIL TO OPEN

System : Chemical and volume control
High pressure injection
Component : Check Valve
Failure Mode : Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 3.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8734960	0.9682380	0.9867710	0.9999360	1.0000000	1.3246E+01	4.3452E-01
α_2	5.92E-05	3.18E-02	1.32E-02	1.27E-01	0.00E+00	4.3452E-01	1.3246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9068390	0.9672900	0.9760300	0.9978250	1.0000000	3.2555E+01	1.1009E+00
α_2	7.91E-04	2.48E-02	1.62E-02	7.82E-02	0.00E+00	8.3366E-01	3.2822E+01
α_3	2.80E-07	7.94E-03	1.61E-03	3.77E-02	0.00E+00	2.6722E-01	3.3389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9130680	0.9636200	0.9695110	0.9939910	1.0000000	4.9136E+01	1.8551E+00
α_2	2.00E-03	2.41E-02	1.82E-02	6.63E-02	0.00E+00	1.2281E+00	4.9763E+01
α_3	8.95E-06	7.93E-03	2.95E-03	3.27E-02	0.00E+00	4.0431E-01	5.0587E+01
α_4	1.89E-08	4.37E-03	5.99E-04	2.19E-02	0.00E+00	2.2267E-01	5.0768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9318350	0.9655480	0.9685320	0.9890570	1.0000000	9.9161E+01	3.5382E+00
α_2	3.97E-03	2.06E-02	1.76E-02	4.76E-02	0.00E+00	2.1142E+00	1.0059E+02
α_3	4.65E-04	9.52E-03	6.58E-03	2.86E-02	0.00E+00	9.7738E-01	1.0172E+02
α_4	2.40E-06	3.65E-03	1.23E-03	1.55E-02	0.00E+00	3.7439E-01	1.0232E+02
α_5	5.81E-21	7.04E-04	3.98E-07	4.08E-03	0.00E+00	7.2277E-02	1.0263E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9351640	0.9655550	0.9680290	0.9874920	1.0000000	1.1994E+02	4.2787E+00
α_2	3.71E-03	1.80E-02	1.55E-02	4.10E-02	0.00E+00	2.2392E+00	1.2198E+02
α_3	6.48E-04	9.19E-03	6.73E-03	2.62E-02	0.00E+00	1.1418E+00	1.2308E+02
α_4	4.26E-05	4.77E-03	2.50E-03	1.72E-02	0.00E+00	5.9222E-01	1.2363E+02
α_5	7.48E-09	1.79E-03	2.43E-04	8.96E-03	0.00E+00	2.2220E-01	1.2400E+02
α_6	1.14E-18	6.70E-04	1.17E-06	3.91E-03	0.00E+00	8.3237E-02	1.2414E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	3.00	3.00	3.00	3.00	3.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.7.4.2 HIGH PRESSURE INJECTION CHECK VALVE FAIL TO CLOSE

System :	Chemical and volume control High pressure injection
Component :	Check Valve
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 8.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9093850	0.9773460	0.9906920	0.9999550	1.0000000	1.8746E+01	4.3452E-01
α_2	4.16E-05	2.27E-02	9.31E-03	9.06E-02	0.00E+00	4.3452E-01	1.8746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9197350	0.9718850	0.9794540	0.9981430	1.0000000	3.8055E+01	1.1009E+00
α_2	6.78E-04	2.13E-02	1.39E-02	6.73E-02	0.00E+00	8.3366E-01	3.8322E+01
α_3	2.40E-07	6.82E-03	1.38E-03	3.24E-02	0.00E+00	2.6722E-01	3.8889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9214020	0.9671620	0.9725130	0.9945900	1.0000000	5.4636E+01	1.8551E+00
α_2	1.80E-03	2.17E-02	1.64E-02	6.00E-02	0.00E+00	1.2281E+00	5.5263E+01
α_3	8.07E-06	7.16E-03	2.66E-03	2.96E-02	0.00E+00	4.0431E-01	5.6087E+01
α_4	1.70E-08	3.94E-03	5.40E-04	1.97E-02	0.00E+00	2.2267E-01	5.6268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9352570	0.9672990	0.9701370	0.9896220	1.0000000	1.0466E+02	3.5382E+00
α_2	3.76E-03	1.95E-02	1.67E-02	4.52E-02	0.00E+00	2.1142E+00	1.0608E+02
α_3	4.41E-04	9.03E-03	6.24E-03	2.72E-02	0.00E+00	9.7738E-01	1.0722E+02
α_4	2.28E-06	3.46E-03	1.17E-03	1.47E-02	0.00E+00	3.7439E-01	1.0782E+02
α_5	5.52E-21	6.68E-04	3.78E-07	3.87E-03	0.00E+00	7.2277E-02	1.0813E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9378820	0.9670160	0.9693880	0.9880300	1.0000000	1.2544E+02	4.2787E+00
α_2	3.55E-03	1.73E-02	1.48E-02	3.92E-02	0.00E+00	2.2392E+00	1.2748E+02
α_3	6.20E-04	8.80E-03	6.44E-03	2.51E-02	0.00E+00	1.1418E+00	1.2858E+02
α_4	4.08E-05	4.57E-03	2.39E-03	1.65E-02	0.00E+00	5.9222E-01	1.2913E+02
α_5	7.16E-09	1.71E-03	2.32E-04	8.58E-03	0.00E+00	2.2220E-01	1.2950E+02
α_6	1.09E-18	6.42E-04	1.12E-06	3.75E-03	0.00E+00	8.3237E-02	1.2964E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	8.50	8.50	8.50	8.50	8.50
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.7.5 PWR Residual Heat Removal Check Valves

1.7.5.1 PWR RHR CHECK VALVE FAIL TO OPEN

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Check Valve
Failure Mode :	Fail to open on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 0.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8386830	0.9593170	0.9828300	0.9999250	1.0000000	1.0246E+01	4.3452E-01
α_2	7.70E-05	4.07E-02	1.72E-02	1.61E-01	0.00E+00	4.3452E-01	1.0246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8979020	0.9640890	0.9736330	0.9976040	1.0000000	2.9555E+01	1.1009E+00
α_2	8.71E-04	2.72E-02	1.78E-02	8.57E-02	0.00E+00	8.3366E-01	2.9822E+01
α_3	3.08E-07	8.72E-03	1.77E-03	4.13E-02	0.00E+00	2.6722E-01	3.0389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9077330	0.9613450	0.9675780	0.9936050	1.0000000	4.6136E+01	1.8551E+00
α_2	2.13E-03	2.56E-02	1.93E-02	7.04E-02	0.00E+00	1.2281E+00	4.6763E+01
α_3	9.52E-06	8.42E-03	3.13E-03	3.48E-02	0.00E+00	4.0431E-01	4.7587E+01
α_4	2.01E-08	4.64E-03	6.37E-04	2.32E-02	0.00E+00	2.2267E-01	4.7768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9298110	0.9645110	0.9675740	0.9887220	1.0000000	9.6161E+01	3.5382E+00
α_2	4.09E-03	2.12E-02	1.81E-02	4.90E-02	0.00E+00	2.1142E+00	9.7585E+01
α_3	4.79E-04	9.80E-03	6.78E-03	2.95E-02	0.00E+00	9.7738E-01	9.8722E+01
α_4	2.47E-06	3.76E-03	1.27E-03	1.59E-02	0.00E+00	3.7439E-01	9.9325E+01
α_5	5.99E-21	7.25E-04	4.10E-07	4.20E-03	0.00E+00	7.2277E-02	9.9627E+01

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9335790	0.9647030	0.9672350	0.9871780	1.0000000	1.1694E+02	4.2787E+00
α_2	3.80E-03	1.85E-02	1.59E-02	4.20E-02	0.00E+00	2.2392E+00	1.1898E+02
α_3	6.64E-04	9.42E-03	6.89E-03	2.68E-02	0.00E+00	1.1418E+00	1.2008E+02
α_4	4.37E-05	4.89E-03	2.56E-03	1.76E-02	0.00E+00	5.9222E-01	1.2063E+02
α_5	7.67E-09	1.83E-03	2.49E-04	9.18E-03	0.00E+00	2.2220E-01	1.2100E+02
α_6	1.16E-18	6.87E-04	1.20E-06	4.01E-03	0.00E+00	8.3237E-02	1.2114E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9422570	0.9661670	0.9677850	0.9845420	1.0000000	1.8405E+02	6.4450E+00
α_2	4.57E-03	1.62E-02	1.45E-02	3.35E-02	0.00E+00	3.0878E+00	1.8741E+02
α_3	1.15E-03	8.56E-03	6.91E-03	2.16E-02	0.00E+00	1.6312E+00	1.8886E+02
α_4	2.60E-04	5.19E-03	3.59E-03	1.56E-02	0.00E+00	9.8887E-01	1.8951E+02
α_5	1.35E-05	2.74E-03	1.30E-03	1.04E-02	0.00E+00	5.2177E-01	1.8997E+02
α_6	3.53E-10	9.78E-04	8.35E-05	5.13E-03	0.00E+00	1.8628E-01	1.9031E+02
α_7	0.00E+00	1.53E-04	1.34E-13	5.75E-04	0.00E+00	2.9071E-02	1.9047E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9454620	0.9670150	0.9683850	0.9838980	1.0000000	2.1873E+02	7.4610E+00
α_2	4.45E-03	1.48E-02	1.34E-02	2.99E-02	0.00E+00	3.3447E+00	2.2285E+02
α_3	1.14E-03	7.69E-03	6.29E-03	1.90E-02	0.00E+00	1.7384E+00	2.2445E+02
α_4	3.59E-04	5.07E-03	3.71E-03	1.44E-02	0.00E+00	1.1465E+00	2.2504E+02
α_5	5.70E-05	3.13E-03	1.84E-03	1.06E-02	0.00E+00	7.0833E-01	2.2548E+02
α_6	9.18E-07	1.62E-03	5.31E-04	6.94E-03	0.00E+00	3.6696E-01	2.2582E+02
α_7	7.20E-14	5.44E-04	9.78E-06	3.10E-03	0.00E+00	1.2297E-01	2.2607E+02
α_8	1.35E-42	1.46E-04	2.09E-12	6.19E-04	0.00E+00	3.3124E-02	2.2616E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.7.5.2 PWR RHR CHECK VALVE FAIL TO CLOSE

System :	Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Check Valve
Failure Mode :	Fail to close (reseat) on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 7.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9044540	0.9761000	0.9901620	0.9999520	1.0000000	1.7746E+01	4.3452E-01
α_2	4.39E-05	2.39E-02	9.84E-03	9.55E-02	0.00E+00	4.3452E-01	1.7746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9176630	0.9711480	0.9789060	0.9980930	1.0000000	3.7055E+01	1.1009E+00
α_2	6.96E-04	2.18E-02	1.42E-02	6.91E-02	0.00E+00	8.3366E-01	3.7322E+01
α_3	2.46E-07	7.00E-03	1.42E-03	3.32E-02	0.00E+00	2.6722E-01	3.7889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9200060	0.9665700	0.9720120	0.9944910	1.0000000	5.3636E+01	1.8551E+00
α_2	1.84E-03	2.21E-02	1.67E-02	6.10E-02	0.00E+00	1.2281E+00	5.4263E+01
α_3	8.22E-06	7.29E-03	2.71E-03	3.01E-02	0.00E+00	4.0431E-01	5.5087E+01
α_4	1.73E-08	4.01E-03	5.50E-04	2.01E-02	0.00E+00	2.2267E-01	5.5268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9346610	0.9669930	0.9698570	0.9895240	1.0000000	1.0366E+02	3.5382E+00
α_2	3.80E-03	1.97E-02	1.68E-02	4.56E-02	0.00E+00	2.1142E+00	1.0508E+02
α_3	4.45E-04	9.12E-03	6.30E-03	2.74E-02	0.00E+00	9.7738E-01	1.0622E+02
α_4	2.30E-06	3.49E-03	1.18E-03	1.48E-02	0.00E+00	3.7439E-01	1.0682E+02
α_5	5.57E-21	6.74E-04	3.81E-07	3.90E-03	0.00E+00	7.2277E-02	1.0713E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9374050	0.9667600	0.9691540	0.9879360	1.0000000	1.2444E+02	4.2787E+00
α_2	3.58E-03	1.74E-02	1.50E-02	3.95E-02	0.00E+00	2.2392E+00	1.2648E+02
α_3	6.25E-04	8.87E-03	6.49E-03	2.53E-02	0.00E+00	1.1418E+00	1.2758E+02
α_4	4.11E-05	4.60E-03	2.41E-03	1.66E-02	0.00E+00	5.9222E-01	1.2813E+02
α_5	7.22E-09	1.73E-03	2.34E-04	8.65E-03	0.00E+00	2.2220E-01	1.2850E+02
α_6	1.10E-18	6.47E-04	1.13E-06	3.77E-03	0.00E+00	8.3237E-02	1.2864E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9444180	0.9674490	0.9690150	0.9851390	1.0000000	1.9155E+02	6.4450E+00
α_2	4.39E-03	1.56E-02	1.40E-02	3.23E-02	0.00E+00	3.0878E+00	1.9491E+02
α_3	1.11E-03	8.24E-03	6.65E-03	2.08E-02	0.00E+00	1.6312E+00	1.9636E+02
α_4	2.50E-04	4.99E-03	3.46E-03	1.50E-02	0.00E+00	9.8887E-01	1.9701E+02
α_5	1.30E-05	2.64E-03	1.25E-03	9.96E-03	0.00E+00	5.2177E-01	1.9747E+02
α_6	3.40E-10	9.41E-04	8.03E-05	4.94E-03	0.00E+00	1.8628E-01	1.9781E+02
α_7	0.00E+00	1.47E-04	1.29E-13	5.53E-04	0.00E+00	2.9071E-02	1.9797E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9471970	0.9680730	0.9694040	0.9844200	1.0000000	2.2623E+02	7.4610E+00
α_2	4.31E-03	1.43E-02	1.30E-02	2.90E-02	0.00E+00	3.3447E+00	2.3035E+02
α_3	1.10E-03	7.44E-03	6.09E-03	1.84E-02	0.00E+00	1.7384E+00	2.3195E+02
α_4	3.47E-04	4.91E-03	3.59E-03	1.40E-02	0.00E+00	1.1465E+00	2.3254E+02
α_5	5.52E-05	3.03E-03	1.78E-03	1.03E-02	0.00E+00	7.0833E-01	2.3298E+02
α_6	8.89E-07	1.57E-03	5.14E-04	6.72E-03	0.00E+00	3.6696E-01	2.3332E+02
α_7	6.97E-14	5.26E-04	9.46E-06	3.00E-03	0.00E+00	1.2297E-01	2.3357E+02
α_8	1.31E-42	1.42E-04	2.02E-12	5.99E-04	0.00E+00	3.3124E-02	2.3366E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	7.50	7.50	7.50	7.50	7.50	7.50	7.50
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.7.6 BWR High Pressure Coolant Injection/Reactor Core Isolation Cooling Check Valves

1.7.6.1 COMBINED HPCI AND RCIC CHECK VALVE FAIL TO OPEN

System : High pressure coolant injection
Reactor core isolation
Component : Check Valve
Failure Mode : Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 1.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8522320	0.9628000	0.9843830	0.9999320	1.0000000	1.1246E+01	4.3452E-01
α_2	7.00E-05	3.72E-02	1.56E-02	1.48E-01	0.00E+00	4.3452E-01	1.1246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9010680	0.9652240	0.9744830	0.9976820	1.0000000	3.0555E+01	1.1009E+00
α_2	8.43E-04	2.63E-02	1.72E-02	8.30E-02	0.00E+00	8.3366E-01	3.0822E+01
α_3	2.98E-07	8.44E-03	1.71E-03	4.00E-02	0.00E+00	2.6722E-01	3.1389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9095820	0.9621340	0.9682530	0.9937390	1.0000000	4.7136E+01	1.8551E+00
α_2	2.09E-03	2.51E-02	1.89E-02	6.90E-02	0.00E+00	1.2281E+00	4.7763E+01
α_3	9.32E-06	8.25E-03	3.07E-03	3.41E-02	0.00E+00	4.0431E-01	4.8587E+01
α_4	1.97E-08	4.55E-03	6.24E-04	2.28E-02	0.00E+00	2.2267E-01	4.8768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9304990	0.9648630	0.9678980	0.9888360	1.0000000	9.7161E+01	3.5382E+00
α_2	4.05E-03	2.10E-02	1.79E-02	4.85E-02	0.00E+00	2.1142E+00	9.8585E+01
α_3	4.74E-04	9.71E-03	6.71E-03	2.92E-02	0.00E+00	9.7738E-01	9.9722E+01
α_4	2.45E-06	3.72E-03	1.25E-03	1.58E-02	0.00E+00	3.7439E-01	1.0032E+02
α_5	5.93E-21	7.18E-04	4.06E-07	4.16E-03	0.00E+00	7.2277E-02	1.0063E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9341160	0.9649920	0.9674990	0.9872840	1.0000000	1.1794E+02	4.2787E+00
α_2	3.77E-03	1.83E-02	1.58E-02	4.16E-02	0.00E+00	2.2392E+00	1.1998E+02
α_3	6.58E-04	9.34E-03	6.84E-03	2.66E-02	0.00E+00	1.1418E+00	1.2108E+02
α_4	4.33E-05	4.85E-03	2.54E-03	1.75E-02	0.00E+00	5.9222E-01	1.2163E+02
α_5	7.60E-09	1.82E-03	2.47E-04	9.11E-03	0.00E+00	2.2220E-01	1.2200E+02
α_6	1.15E-18	6.81E-04	1.19E-06	3.98E-03	0.00E+00	8.3237E-02	1.2214E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	1.00	1.00	1.00	1.00	1.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.7.6.2 COMBINED HPCI AND RCIC CHECK VALVE FAIL TO CLOSE

System :	High pressure coolant injection Reactor core isolation
Component :	Check Valve
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 4.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8819910	0.9704020	0.9877120	0.9999410	1.0000000	1.4246E+01	4.3452E-01
α_2	5.49E-05	2.96E-02	1.23E-02	1.18E-01	0.00E+00	4.3452E-01	1.4246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9094830	0.9682340	0.9767350	0.9978890	1.0000000	3.3555E+01	1.1009E+00
α_2	7.68E-04	2.41E-02	1.57E-02	7.59E-02	0.00E+00	8.3366E-01	3.3822E+01
α_3	2.71E-07	7.71E-03	1.56E-03	3.66E-02	0.00E+00	2.6722E-01	3.4389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9147120	0.9643190	0.9701040	0.9941100	1.0000000	5.0136E+01	1.8551E+00
α_2	1.96E-03	2.36E-02	1.78E-02	6.51E-02	0.00E+00	1.2281E+00	5.0763E+01
α_3	8.78E-06	7.78E-03	2.89E-03	3.21E-02	0.00E+00	4.0431E-01	5.1587E+01
α_4	1.85E-08	4.28E-03	5.88E-04	2.15E-02	0.00E+00	2.2267E-01	5.1768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9324830	0.9658790	0.9688380	0.9891640	1.0000000	1.0016E+02	3.5382E+00
α_2	3.93E-03	2.04E-02	1.74E-02	4.71E-02	0.00E+00	2.1142E+00	1.0158E+02
α_3	4.61E-04	9.43E-03	6.51E-03	2.83E-02	0.00E+00	9.7738E-01	1.0272E+02
α_4	2.37E-06	3.61E-03	1.22E-03	1.53E-02	0.00E+00	3.7439E-01	1.0332E+02
α_5	5.76E-21	6.97E-04	3.94E-07	4.04E-03	0.00E+00	7.2277E-02	1.0363E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9356760	0.9658310	0.9682860	0.9875940	1.0000000	1.2094E+02	4.2787E+00
α_2	3.68E-03	1.79E-02	1.54E-02	4.06E-02	0.00E+00	2.2392E+00	1.2298E+02
α_3	6.42E-04	9.12E-03	6.67E-03	2.60E-02	0.00E+00	1.1418E+00	1.2408E+02
α_4	4.23E-05	4.73E-03	2.48E-03	1.71E-02	0.00E+00	5.9222E-01	1.2463E+02
α_5	7.42E-09	1.77E-03	2.41E-04	8.89E-03	0.00E+00	2.2220E-01	1.2500E+02
α_6	1.13E-18	6.65E-04	1.16E-06	3.88E-03	0.00E+00	8.3237E-02	1.2514E+02

ALPHA FACTOR and MGL PARAMETERS

BWR High Pressure Coolant Injection/Reactor Core Isolation Cooling Check Valves
COMBINED HPCI AND RCIC CHECK VALVE FAIL TO CLOSE

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	4.00	4.00	4.00	4.00	4.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.8 Strainers, Trash Racks, and Filters

1.8.1 Pooled Strainers (Non-ESW)

1.8.1.1 GENERIC CLEAN DISCHARGE STRAINER PLUGS

System :	Chemical and volume control Component cooling water Control rod drive High pressure injection Standby liquid control
Component :	Strainer
Failure Mode :	No flow/plugged
Component Group :	Passive filter
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 0.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8386830	0.9593170	0.9828300	0.9999250	0.9871680	1.0246E+01	4.3452E-01
α_2	7.70E-05	4.07E-02	1.72E-02	1.61E-01	0.00E+00	4.3452E-01	1.0246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8979020	0.9640890	0.9736330	0.9976040	0.9871680	2.9555E+01	1.1009E+00
α_2	8.71E-04	2.72E-02	1.78E-02	8.57E-02	0.00E+00	8.3366E-01	2.9822E+01
α_3	3.08E-07	8.72E-03	1.77E-03	4.13E-02	0.00E+00	2.6722E-01	3.0389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9077330	0.9613450	0.9675780	0.9936050	0.9871680	4.6136E+01	1.8551E+00
α_2	2.13E-03	2.56E-02	1.93E-02	7.04E-02	0.00E+00	1.2281E+00	4.6763E+01
α_3	9.52E-06	8.42E-03	3.13E-03	3.48E-02	0.00E+00	4.0431E-01	4.7587E+01
α_4	2.01E-08	4.64E-03	6.37E-04	2.32E-02	0.00E+00	2.2267E-01	4.7768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9298110	0.9645110	0.9675740	0.9887220	0.9871680	9.6161E+01	3.5382E+00
α_2	4.09E-03	2.12E-02	1.81E-02	4.90E-02	0.00E+00	2.1142E+00	9.7585E+01
α_3	4.79E-04	9.80E-03	6.78E-03	2.95E-02	0.00E+00	9.7738E-01	9.8722E+01
α_4	2.47E-06	3.76E-03	1.27E-03	1.59E-02	0.00E+00	3.7439E-01	9.9325E+01
α_5	5.99E-21	7.25E-04	4.10E-07	4.20E-03	0.00E+00	7.2277E-02	9.9627E+01

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9335790	0.9647030	0.9672350	0.9871780	0.9871680	1.1694E+02	4.2787E+00
α_2	3.80E-03	1.85E-02	1.59E-02	4.20E-02	0.00E+00	2.2392E+00	1.1898E+02
α_3	6.64E-04	9.42E-03	6.89E-03	2.68E-02	0.00E+00	1.1418E+00	1.2008E+02
α_4	4.37E-05	4.89E-03	2.56E-03	1.76E-02	0.00E+00	5.9222E-01	1.2063E+02
α_5	7.67E-09	1.83E-03	2.49E-04	9.18E-03	0.00E+00	2.2220E-01	1.2100E+02
α_6	1.16E-18	6.87E-04	1.20E-06	4.01E-03	0.00E+00	8.3237E-02	1.2114E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9871680	0.9871680	0.9871680	0.9871680	0.9871680
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	0.00	0.00	0.00	0.00	0.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.8.2 Emergency Service Water Strainers

1.8.2.1 SERVICE WATER TSA FTO NON ENVIRONMENTAL SPAR:TSA-FO

System :	Normally operating service water
	Standby service water
Component :	Strainer
Failure Mode :	Fail to Operate (General operation failure, rate based)
Component Group :	Traveling Screen
Prox. Cause :	State of other component
	Design error or inadequacy
	Manufacturing error or inadequacy
	Construction installation error or inadequacy
	Setpoint drift
	Ambient environmental stress
	Inadequate procedure
	Inadequate maintenance
	Age or Wear
	Accidental human action
	Human action procedure
	Other
	Internal environment
	Internal to component; piece-part
Filter Indep. by Cause? :	True
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 30.00
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9232150	0.9800590	0.9909440	0.9999280	0.9963280	2.3813E+01	4.8452E-01
α_2	6.83E-05	1.99E-02	9.05E-03	7.68E-02	3.67E-03	4.8452E-01	2.3813E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9328760	0.9754760	0.9813770	0.9978820	0.9926290	4.9755E+01	1.2509E+00
α_2	9.67E-04	1.93E-02	1.35E-02	5.75E-02	7.37E-03	9.8366E-01	5.0022E+01
α_3	1.83E-07	5.24E-03	1.06E-03	2.49E-02	0.00E+00	2.6722E-01	5.0739E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9342680	0.9712750	0.9753600	0.9943090	0.9889030	7.2869E+01	2.1551E+00
α_2	2.50E-03	2.04E-02	1.63E-02	5.22E-02	1.11E-02	1.5281E+00	7.3496E+01
α_3	6.06E-06	5.39E-03	2.00E-03	2.23E-02	0.00E+00	4.0431E-01	7.4620E+01
α_4	1.28E-08	2.97E-03	4.06E-04	1.49E-02	0.00E+00	2.2267E-01	7.4801E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9421370	0.9697720	0.9720940	0.9894720	0.9853480	1.2934E+02	4.0315E+00
α_2	4.71E-03	1.95E-02	1.72E-02	4.24E-02	1.46E-02	2.6042E+00	1.3077E+02
α_3	3.62E-04	7.35E-03	5.08E-03	2.21E-02	9.80E-05	9.8068E-01	1.3239E+02
α_4	1.84E-06	2.81E-03	9.45E-04	1.19E-02	0.00E+00	3.7439E-01	1.3300E+02
α_5	4.47E-21	5.42E-04	3.06E-07	3.14E-03	0.00E+00	7.2277E-02	1.3330E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9437740	0.9689660	0.9708820	0.9875990	0.9818060	1.5646E+02	5.0111E+00
α_2	5.00E-03	1.84E-02	1.64E-02	3.84E-02	1.80E-02	2.9631E+00	1.5851E+02
α_3	5.09E-04	7.12E-03	5.22E-03	2.02E-02	2.09E-04	1.1502E+00	1.6032E+02
α_4	3.28E-05	3.67E-03	1.92E-03	1.32E-02	2.48E-06	5.9232E-01	1.6088E+02
α_5	5.75E-09	1.38E-03	1.86E-04	6.89E-03	0.00E+00	2.2220E-01	1.6125E+02
α_6	8.73E-19	5.15E-04	9.01E-07	3.01E-03	0.00E+00	8.3237E-02	1.6139E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9963280	0.9926290	0.9889030	0.9853480	0.9818060
α_2	3.67E-03	7.37E-03	1.11E-02	1.46E-02	1.80E-02
α_3		0.00E+00	0.00E+00	9.80E-05	2.09E-04
α_4			0.00E+00	0.00E+00	2.48E-06
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.96E-01	9.93E-01	9.89E-01	9.85E-01	9.82E-01
Beta	3.67E-03	7.37E-03	1.11E-02	1.47E-02	1.82E-02
Gamma		0.00E+00	0.00E+00	6.69E-03	1.16E-02
Delta			0.00E+00	0.00E+00	1.18E-02
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	12.00	18.00	24.00	30.00	36.00
N_1	1.5667	2.2000	2.7333	3.1750	3.5230
N_2	0.0500	0.1500	0.3000	0.4900	0.7239
N_3		0.0000	0.0000	0.0033	0.0084
N_4			0.0000	0.0000	0.0001
N_5				0.0000	0.0000
N_6					0.0000

1.8.2.2 SERVICE WATER TSA PLUG NON ENVIRONMENTAL SPAR:TSA-PG

System :	Circulating water system
	Normally operating service water
	Standby service water
Component :	Strainer
Failure Mode :	No flow/plugged
Component Group :	Traveling Screen
Prox. Cause :	State of other component
	Design error or inadequacy
	Manufacturing error or inadequacy
	Construction installation error or inadequacy
	Setpoint drift
	Ambient environmental stress
	Inadequate procedure
	Inadequate maintenance
	Age or Wear
	Accidental human action
	Human action procedure
	Other
	Internal environment
	Internal to component; piece-part
Filter Indep. by Cause? :	True
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 10.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9159000	0.9789890	0.9913880	0.9999580	1.0000000	2.0246E+01	4.3452E-01
α_2	3.84E-05	2.10E-02	8.61E-03	8.41E-02	0.00E+00	4.3452E-01	2.0246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9226540	0.9729220	0.9802250	0.9982130	1.0000000	3.9555E+01	1.1009E+00
α_2	6.52E-04	2.05E-02	1.33E-02	6.49E-02	0.00E+00	8.3366E-01	3.9822E+01
α_3	2.31E-07	6.57E-03	1.33E-03	3.12E-02	0.00E+00	2.6722E-01	4.0389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9234090	0.9680110	0.9732370	0.9947340	1.0000000	5.6136E+01	1.8551E+00
α_2	1.76E-03	2.12E-02	1.60E-02	5.84E-02	0.00E+00	1.2281E+00	5.6763E+01
α_3	7.86E-06	6.97E-03	2.59E-03	2.88E-02	0.00E+00	4.0431E-01	5.7587E+01
α_4	1.66E-08	3.84E-03	5.26E-04	1.92E-02	0.00E+00	2.2267E-01	5.7768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9361320	0.9677460	0.9705480	0.9897660	1.0000000	1.0616E+02	3.5382E+00
α_2	3.71E-03	1.93E-02	1.64E-02	4.45E-02	0.00E+00	2.1142E+00	1.0758E+02
α_3	4.35E-04	8.91E-03	6.16E-03	2.68E-02	0.00E+00	9.7738E-01	1.0872E+02
α_4	2.24E-06	3.41E-03	1.15E-03	1.45E-02	0.00E+00	3.7439E-01	1.0932E+02
α_5	5.44E-21	6.59E-04	3.73E-07	3.81E-03	0.00E+00	7.2277E-02	1.0963E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9385840	0.9673930	0.9697400	0.9881690	1.0000000	1.2694E+02	4.2787E+00
α_2	3.51E-03	1.71E-02	1.47E-02	3.88E-02	0.00E+00	2.2392E+00	1.2898E+02
α_3	6.13E-04	8.70E-03	6.37E-03	2.48E-02	0.00E+00	1.1418E+00	1.3008E+02
α_4	4.04E-05	4.51E-03	2.36E-03	1.63E-02	0.00E+00	5.9222E-01	1.3063E+02
α_5	7.08E-09	1.69E-03	2.30E-04	8.48E-03	0.00E+00	2.2220E-01	1.3100E+02
α_6	1.07E-18	6.34E-04	1.11E-06	3.70E-03	0.00E+00	8.3237E-02	1.3114E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	10.00	10.00	10.00	10.00	10.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.8.2.3 SERVICE WATER STRAINER PLUG NON ENVIRONMENTAL SPAR:STR-PG

System :	Normally operating service water
	Standby service water
Component :	Strainer
Failure Mode :	High dP across filter
	No flow/plugged
Component Group :	Self-Cleaning strainer
Prox. Cause :	State of other component
	Design error or inadequacy
	Manufacturing error or inadequacy
	Construction installation error or inadequacy
	Setpoint drift
	Ambient environmental stress
	Inadequate procedure
	Inadequate maintenance
	Age or Wear
	Accidental human action
	Human action procedure
	Other
	Internal environment
	Internal to component; piece-part
Filter Indep. by Cause? :	True
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 32.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9145420	0.9671590	0.9740070	0.9963360	0.9696970	4.2246E+01	1.4345E+00
α_2	3.67E-03	3.28E-02	2.60E-02	8.55E-02	3.03E-02	1.4345E+00	4.2246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9391060	0.9736250	0.9774870	0.9949380	0.9795920	7.7555E+01	2.1009E+00
α_2	1.62E-03	1.67E-02	1.29E-02	4.50E-02	1.02E-02	1.3337E+00	7.8322E+01
α_3	2.33E-04	9.63E-03	5.95E-03	3.16E-02	1.02E-02	7.6722E-01	7.8889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9467420	0.9747330	0.9774840	0.9933190	0.9846150	1.1014E+02	2.8551E+00
α_2	1.51E-03	1.31E-02	1.03E-02	3.40E-02	3.85E-03	1.4781E+00	1.1152E+02
α_3	3.18E-04	8.00E-03	5.35E-03	2.47E-02	7.69E-03	9.0431E-01	1.1209E+02
α_4	1.22E-05	4.18E-03	1.82E-03	1.64E-02	3.85E-03	4.7267E-01	1.1252E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9532810	0.9748850	0.9766200	0.9905740	0.9876540	1.7616E+02	4.5383E+00
α_2	2.54E-03	1.24E-02	1.06E-02	2.82E-02	1.54E-03	2.2392E+00	1.7846E+02
α_3	7.38E-04	7.48E-03	5.76E-03	2.01E-02	4.63E-03	1.3524E+00	1.7935E+02
α_4	9.21E-05	4.15E-03	2.52E-03	1.37E-02	4.63E-03	7.4939E-01	1.7995E+02
α_5	9.19E-10	1.09E-03	1.10E-04	5.65E-03	1.54E-03	1.9728E-01	1.8050E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9566260	0.9758100	0.9772530	0.9900750	0.9896910	2.1294E+02	5.2787E+00
α_2	2.23E-03	1.05E-02	9.09E-03	2.38E-02	6.44E-04	2.3017E+00	2.1592E+02
α_3	6.61E-04	6.38E-03	4.95E-03	1.70E-02	2.58E-03	1.3918E+00	2.1683E+02
α_4	2.10E-04	4.43E-03	3.04E-03	1.34E-02	3.87E-03	9.6722E-01	2.1725E+02
α_5	6.25E-06	2.16E-03	9.37E-04	8.48E-03	2.58E-03	4.7220E-01	2.1775E+02
α_6	3.41E-12	6.68E-04	2.49E-05	3.70E-03	6.44E-04	1.4574E-01	2.1807E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9696970	0.9795920	0.9846150	0.9876540	0.9896910
α_2	3.03E-02	1.02E-02	3.85E-03	1.54E-03	6.44E-04
α_3		1.02E-02	7.69E-03	4.63E-03	2.58E-03
α_4			3.85E-03	4.63E-03	3.87E-03
α_5				1.54E-03	2.58E-03
α_6					6.44E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.70E-01	9.80E-01	9.85E-01	9.88E-01	9.90E-01
Beta	3.03E-02	2.04E-02	1.54E-02	1.23E-02	1.03E-02
Gamma		5.00E-01	7.50E-01	8.75E-01	9.38E-01
Delta			3.33E-01	5.71E-01	7.33E-01
Epsilon				2.50E-01	4.55E-01
Mu					2.00E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	32.00	48.00	64.00	80.00	96.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	1.0000	0.5000	0.2500	0.1250	0.0625
N_3		0.5000	0.5000	0.3750	0.2500
N_4			0.2500	0.3750	0.3750
N_5				0.1250	0.2500
N_6					0.0625

1.8.2.4 ESW STRAINER PLUG POOLED CAUSES SPAR:ESW-STR-POOL-PG

System :	Normally operating service water
	Standby service water
Component :	Strainer
Failure Mode :	High dP across filter
	No flow/plugged
Component Group :	Self-Cleaning strainer
Prox. Cause :	State of other component
	Design error or inadequacy
	Manufacturing error or inadequacy
	Construction installation error or inadequacy
	Setpoint drift
	Ambient environmental stress
	Inadequate procedure
	Inadequate maintenance
	Age or Wear
	Accidental human action
	Human action procedure
	Other
	Internal environment
	Internal to component; piece-part
Filter Indep. by Cause? :	True
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 32.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9145420	0.9671590	0.9740070	0.9963360	0.9696970	4.2246E+01	1.4345E+00
α_2	3.67E-03	3.28E-02	2.60E-02	8.55E-02	3.03E-02	1.4345E+00	4.2246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9391060	0.9736250	0.9774870	0.9949380	0.9795920	7.7555E+01	2.1009E+00
α_2	1.62E-03	1.67E-02	1.29E-02	4.50E-02	1.02E-02	1.3337E+00	7.8322E+01
α_3	2.33E-04	9.63E-03	5.95E-03	3.16E-02	1.02E-02	7.6722E-01	7.8889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9467420	0.9747330	0.9774840	0.9933190	0.9846150	1.1014E+02	2.8551E+00
α_2	1.51E-03	1.31E-02	1.03E-02	3.40E-02	3.85E-03	1.4781E+00	1.1152E+02
α_3	3.18E-04	8.00E-03	5.35E-03	2.47E-02	7.69E-03	9.0431E-01	1.1209E+02
α_4	1.22E-05	4.18E-03	1.82E-03	1.64E-02	3.85E-03	4.7267E-01	1.1252E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9532810	0.9748850	0.9766200	0.9905740	0.9876540	1.7616E+02	4.5383E+00
α_2	2.54E-03	1.24E-02	1.06E-02	2.82E-02	1.54E-03	2.2392E+00	1.7846E+02
α_3	7.38E-04	7.48E-03	5.76E-03	2.01E-02	4.63E-03	1.3524E+00	1.7935E+02
α_4	9.21E-05	4.15E-03	2.52E-03	1.37E-02	4.63E-03	7.4939E-01	1.7995E+02
α_5	9.19E-10	1.09E-03	1.10E-04	5.65E-03	1.54E-03	1.9728E-01	1.8050E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9566260	0.9758100	0.9772530	0.9900750	0.9896910	2.1294E+02	5.2787E+00
α_2	2.23E-03	1.05E-02	9.09E-03	2.38E-02	6.44E-04	2.3017E+00	2.1592E+02
α_3	6.61E-04	6.38E-03	4.95E-03	1.70E-02	2.58E-03	1.3918E+00	2.1683E+02
α_4	2.10E-04	4.43E-03	3.04E-03	1.34E-02	3.87E-03	9.6722E-01	2.1725E+02
α_5	6.25E-06	2.16E-03	9.37E-04	8.48E-03	2.58E-03	4.7220E-01	2.1775E+02
α_6	3.41E-12	6.68E-04	2.49E-05	3.70E-03	6.44E-04	1.4574E-01	2.1807E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9696970	0.9795920	0.9846150	0.9876540	0.9896910
α_2	3.03E-02	1.02E-02	3.85E-03	1.54E-03	6.44E-04
α_3		1.02E-02	7.69E-03	4.63E-03	2.58E-03
α_4			3.85E-03	4.63E-03	3.87E-03
α_5				1.54E-03	2.58E-03
α_6					6.44E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.70E-01	9.80E-01	9.85E-01	9.88E-01	9.90E-01
Beta	3.03E-02	2.04E-02	1.54E-02	1.23E-02	1.03E-02
Gamma		5.00E-01	7.50E-01	8.75E-01	9.38E-01
Delta			3.33E-01	5.71E-01	7.33E-01
Epsilon				2.50E-01	4.55E-01
Mu					2.00E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	32.00	48.00	64.00	80.00	96.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	1.0000	0.5000	0.2500	0.1250	0.0625
N_3		0.5000	0.5000	0.3750	0.2500
N_4			0.2500	0.3750	0.3750
N_5				0.1250	0.2500
N_6					0.0625

1.8.3 Pooled Sump Strainers

1.8.3.1 SUMP SUCTION PLUGGED

System :	Containment spray recirculation High pressure core spray High pressure coolant injection Low pressure core spray Reactor core isolation Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Strainer
Failure Mode :	High dP across filter No flow/plugged
Component Group :	Sump Strainer Filter
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 1.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8581890	0.9643270	0.9850590	0.9999350	1.0000000	1.1746E+01	4.3452E-01
α_2	6.69E-05	3.57E-02	1.49E-02	1.42E-01	0.00E+00	4.3452E-01	1.1746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9025780	0.9657640	0.9748880	0.9977200	1.0000000	3.1055E+01	1.1009E+00
α_2	8.29E-04	2.59E-02	1.69E-02	8.18E-02	0.00E+00	8.3366E-01	3.1322E+01
α_3	2.93E-07	8.31E-03	1.69E-03	3.94E-02	0.00E+00	2.6722E-01	3.1889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9104790	0.9625170	0.9685780	0.9938040	1.0000000	4.7636E+01	1.8551E+00
α_2	2.06E-03	2.48E-02	1.87E-02	6.83E-02	0.00E+00	1.2281E+00	4.8263E+01
α_3	9.23E-06	8.17E-03	3.04E-03	3.37E-02	0.00E+00	4.0431E-01	4.9087E+01
α_4	1.95E-08	4.50E-03	6.18E-04	2.25E-02	0.00E+00	2.2267E-01	4.9268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9308380	0.9650370	0.9680620	0.9888920	1.0000000	9.7661E+01	3.5382E+00
α_2	4.03E-03	2.09E-02	1.78E-02	4.83E-02	0.00E+00	2.1142E+00	9.9085E+01
α_3	4.72E-04	9.66E-03	6.68E-03	2.90E-02	0.00E+00	9.7738E-01	1.0022E+02
α_4	2.43E-06	3.70E-03	1.25E-03	1.57E-02	0.00E+00	3.7439E-01	1.0082E+02
α_5	5.90E-21	7.14E-04	4.04E-07	4.14E-03	0.00E+00	7.2277E-02	1.0113E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9343810	0.9651340	0.9676320	0.9873370	1.0000000	1.1844E+02	4.2787E+00
α_2	3.75E-03	1.82E-02	1.57E-02	4.15E-02	0.00E+00	2.2392E+00	1.2048E+02
α_3	6.56E-04	9.30E-03	6.81E-03	2.65E-02	0.00E+00	1.1418E+00	1.2158E+02
α_4	4.32E-05	4.83E-03	2.53E-03	1.74E-02	0.00E+00	5.9222E-01	1.2213E+02
α_5	7.57E-09	1.81E-03	2.46E-04	9.07E-03	0.00E+00	2.2220E-01	1.2250E+02
α_6	1.15E-18	6.78E-04	1.19E-06	3.96E-03	0.00E+00	8.3237E-02	1.2264E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	1.50	1.50	1.50	1.50	1.50
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.8.4 PWR Containment Sump Strainers

1.8.4.1 CONTAINMENT SPRAY SUMP STRAINER PLUG STR-PG

System : Containment spray recirculation
Component : Strainer
Failure Mode : High dP across filter
No flow/plugged
Component Group : Sump Strainer Filter
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 0.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8386830	0.9593170	0.9828300	0.9999250	1.0000000	1.0246E+01	4.3452E-01
α_2	7.70E-05	4.07E-02	1.72E-02	1.61E-01	0.00E+00	4.3452E-01	1.0246E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	1.0000000
α_2	0.00E+00

MGL Parameter	CCCG=2
1-Beta	0.00E+00
Beta	0.00E+00

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	0.00
N_1	0.0000
N_2	0.0000

1.8.5 BWR Suppression Pool Strainers

1.8.5.1 BWR RHR SUMP STRAINER PLUG

System :	High pressure core spray High pressure coolant injection Low pressure core spray Reactor core isolation Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component :	Strainer
Failure Mode :	High dP across filter No flow/plugged
Component Group :	Sump Strainer Filter
Plant Type :	BWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 0.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8386830	0.9593170	0.9828300	0.9999250	0.9877750	1.0246E+01	4.3452E-01
α_2	7.70E-05	4.07E-02	1.72E-02	1.61E-01	0.00E+00	4.3452E-01	1.0246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8979020	0.9640890	0.9736330	0.9976040	0.9877750	2.9555E+01	1.1009E+00
α_2	8.71E-04	2.72E-02	1.78E-02	8.57E-02	0.00E+00	8.3366E-01	2.9822E+01
α_3	3.08E-07	8.72E-03	1.77E-03	4.13E-02	0.00E+00	2.6722E-01	3.0389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9077330	0.9613450	0.9675780	0.9936050	0.9877750	4.6136E+01	1.8551E+00
α_2	2.13E-03	2.56E-02	1.93E-02	7.04E-02	0.00E+00	1.2281E+00	4.6763E+01
α_3	9.52E-06	8.42E-03	3.13E-03	3.48E-02	0.00E+00	4.0431E-01	4.7587E+01
α_4	2.01E-08	4.64E-03	6.37E-04	2.32E-02	0.00E+00	2.2267E-01	4.7768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9298110	0.9645110	0.9675740	0.9887220	0.9877750	9.6161E+01	3.5382E+00
α_2	4.09E-03	2.12E-02	1.81E-02	4.90E-02	0.00E+00	2.1142E+00	9.7585E+01
α_3	4.79E-04	9.80E-03	6.78E-03	2.95E-02	0.00E+00	9.7738E-01	9.8722E+01
α_4	2.47E-06	3.76E-03	1.27E-03	1.59E-02	0.00E+00	3.7439E-01	9.9325E+01
α_5	5.99E-21	7.25E-04	4.10E-07	4.20E-03	0.00E+00	7.2277E-02	9.9627E+01

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9335790	0.9647030	0.9672350	0.9871780	0.9877750	1.1694E+02	4.2787E+00
α_2	3.80E-03	1.85E-02	1.59E-02	4.20E-02	0.00E+00	2.2392E+00	1.1898E+02
α_3	6.64E-04	9.42E-03	6.89E-03	2.68E-02	0.00E+00	1.1418E+00	1.2008E+02
α_4	4.37E-05	4.89E-03	2.56E-03	1.76E-02	0.00E+00	5.9222E-01	1.2063E+02
α_5	7.67E-09	1.83E-03	2.49E-04	9.18E-03	0.00E+00	2.2220E-01	1.2100E+02
α_6	1.16E-18	6.87E-04	1.20E-06	4.01E-03	0.00E+00	8.3237E-02	1.2114E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9877750	0.9877750	0.9877750	0.9877750	0.9877750
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	0.00	0.00	0.00	0.00	0.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.8.6 Extreme Environmental Event CCF Distributions

1.8.6.1 CIRCULATING WATER TSA EXTREME ENVIRONMENTAL PLUG

System :	Circulating water system
Component :	Strainer
Failure Mode :	No flow/plugged
Component Group :	Traveling Screen
Prox. Cause :	Extreme environmental stress
Filter Indep. by Cause? :	True
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 23.00
Total Number of Common-Cause Failure Events: 16

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.5832720	0.7123870	0.7163590	0.8278970	0.6080770	2.5621E+01	1.0344E+01
α_2	1.72E-01	2.88E-01	2.84E-01	4.17E-01	3.92E-01	1.0344E+01	2.5621E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.6920750	0.7823240	0.7853550	0.8622100	0.6065250	4.8779E+01	1.3572E+01
α_2	4.54E-02	9.91E-02	9.48E-02	1.67E-01	1.69E-01	6.1766E+00	5.6175E+01
α_3	5.94E-02	1.19E-01	1.15E-01	1.92E-01	2.25E-01	7.3958E+00	5.4956E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.7303170	0.8044410	0.8068240	0.8704140	0.6026790	6.8629E+01	1.6684E+01
α_2	3.71E-02	7.84E-02	7.52E-02	1.31E-01	1.46E-01	6.6924E+00	7.8620E+01
α_3	3.05E-02	6.90E-02	6.56E-02	1.19E-01	1.47E-01	5.8853E+00	7.9427E+01
α_4	1.71E-02	4.81E-02	4.46E-02	9.11E-02	1.04E-01	4.1060E+00	8.1207E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8138920	0.8637720	0.8654750	0.9078320	0.6284640	1.2298E+02	1.9396E+01
α_2	1.74E-02	4.02E-02	3.81E-02	7.04E-02	8.47E-02	5.7273E+00	1.3665E+02
α_3	2.37E-02	4.96E-02	4.75E-02	8.25E-02	1.42E-01	7.0548E+00	1.3532E+02
α_4	1.26E-02	3.28E-02	3.06E-02	6.04E-02	1.01E-01	4.6661E+00	1.3771E+02
α_5	2.37E-03	1.37E-02	1.15E-02	3.25E-02	4.39E-02	1.9473E+00	1.4043E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8368180	0.8801770	0.8816780	0.9184170	0.6668050	1.4896E+02	2.0279E+01
α_2	5.82E-03	1.95E-02	1.76E-02	3.95E-02	2.21E-02	3.2997E+00	1.6594E+02
α_3	2.14E-02	4.38E-02	4.20E-02	7.23E-02	1.30E-01	7.4077E+00	1.6183E+02
α_4	1.40E-02	3.30E-02	3.11E-02	5.82E-02	1.04E-01	5.5783E+00	1.6366E+02
α_5	4.79E-03	1.76E-02	1.57E-02	3.67E-02	5.73E-02	2.9722E+00	1.6627E+02
α_6	3.27E-04	6.03E-03	4.23E-03	1.79E-02	1.95E-02	1.0207E+00	1.6822E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.6080770	0.6065250	0.6026790	0.6284640	0.6668050
α_2	3.92E-01	1.69E-01	1.46E-01	8.47E-02	2.21E-02
α_3		2.25E-01	1.47E-01	1.42E-01	1.30E-01
α_4			1.04E-01	1.01E-01	1.04E-01
α_5				4.39E-02	5.73E-02
α_6					1.95E-02

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	6.08E-01	6.07E-01	6.03E-01	6.28E-01	6.67E-01
Beta	3.92E-01	3.93E-01	3.97E-01	3.72E-01	3.33E-01
Gamma		5.72E-01	6.32E-01	7.72E-01	9.34E-01
Delta			4.15E-01	5.04E-01	5.81E-01
Epsilon				3.04E-01	4.25E-01
Mu					2.54E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	10.67	16.01	21.35	26.68	32.02
N_1	4.7048	3.2143	1.1429	0.1429	0.0000
N_2	9.9095	5.3429	5.4643	3.6131	1.0605
N_3		7.1286	5.4810	6.0774	6.2659
N_4			3.8833	4.2917	4.9861
N_5				1.8750	2.7500
N_6					0.9375

1.8.6.2 CIRCULATING WATER TSA NON ENVIRONMENTAL PLUG SPAR:CWS-PG

System :	Circulating water system
Component :	Strainer
Failure Mode :	No flow/plugged
Component Group :	Traveling Screen
Prox. Cause :	State of other component Design error or inadequacy Manufacturing error or inadequacy Construction installation error or inadequacy Setpoint drift Ambient environmental stress Inadequate procedure Inadequate maintenance Age or Wear Accidental human action Human action procedure Other Internal environment Internal to component; piece-part Unknown
Filter Indep. by Cause? :	True
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 9.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9116630	0.9779210	0.9909360	0.9999560	1.0000000	1.9246E+01	4.3452E-01
α_2	4.05E-05	2.21E-02	9.06E-03	8.83E-02	0.00E+00	4.3452E-01	1.9246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9207320	0.9722390	0.9797180	0.9981670	1.0000000	3.8555E+01	1.1009E+00
α_2	6.69E-04	2.10E-02	1.37E-02	6.65E-02	0.00E+00	8.3366E-01	3.8822E+01
α_3	2.37E-07	6.74E-03	1.36E-03	3.20E-02	0.00E+00	2.6722E-01	3.9389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9220800	0.9674500	0.9727570	0.9946390	1.0000000	5.5136E+01	1.8551E+00
α_2	1.79E-03	2.15E-02	1.63E-02	5.94E-02	0.00E+00	1.2281E+00	5.5763E+01
α_3	8.00E-06	7.09E-03	2.63E-03	2.93E-02	0.00E+00	4.0431E-01	5.6587E+01
α_4	1.69E-08	3.91E-03	5.36E-04	1.96E-02	0.00E+00	2.2267E-01	5.6768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9355510	0.9674490	0.9702750	0.9896710	1.0000000	1.0516E+02	3.5382E+00
α_2	3.75E-03	1.95E-02	1.66E-02	4.50E-02	0.00E+00	2.1142E+00	1.0658E+02
α_3	4.39E-04	8.99E-03	6.21E-03	2.70E-02	0.00E+00	9.7738E-01	1.0772E+02
α_4	2.26E-06	3.44E-03	1.16E-03	1.46E-02	0.00E+00	3.7439E-01	1.0832E+02
α_5	5.49E-21	6.65E-04	3.76E-07	3.85E-03	0.00E+00	7.2277E-02	1.0863E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9381170	0.9671430	0.9695070	0.9880770	1.0000000	1.2594E+02	4.2787E+00
α_2	3.53E-03	1.72E-02	1.48E-02	3.91E-02	0.00E+00	2.2392E+00	1.2798E+02
α_3	6.17E-04	8.77E-03	6.41E-03	2.50E-02	0.00E+00	1.1418E+00	1.2908E+02
α_4	4.07E-05	4.55E-03	2.38E-03	1.64E-02	0.00E+00	5.9222E-01	1.2963E+02
α_5	7.13E-09	1.71E-03	2.31E-04	8.55E-03	0.00E+00	2.2220E-01	1.3000E+02
α_6	1.08E-18	6.39E-04	1.12E-06	3.73E-03	0.00E+00	8.3237E-02	1.3014E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	9.00	9.00	9.00	9.00	9.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.8.6.3 SERVICE WATER STRAINER PLUG ENVIRONMENTAL SPAR:STR-EE-PG

System :	Normally operating service water Standby service water
Component :	Strainer
Failure Mode :	High dP across filter No flow/plugged
Component Group :	Self-Cleaning strainer
Prox. Cause :	Extreme environmental stress
Filter Indep. by Cause? :	True
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 15.00
Total Number of Common-Cause Failure Events: 5

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.7931930	0.9014330	0.9115190	0.9750790	0.8620810	2.3789E+01	2.6012E+00
α_2	2.49E-02	9.86E-02	8.85E-02	2.07E-01	1.38E-01	2.6012E+00	2.3789E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8320560	0.9056720	0.9108290	0.9616360	0.8229690	4.7375E+01	4.9342E+00
α_2	2.52E-02	7.33E-02	6.79E-02	1.40E-01	1.39E-01	3.8337E+00	4.8475E+01
α_3	1.38E-03	2.10E-02	1.53E-02	6.03E-02	3.85E-02	1.1005E+00	5.1209E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8534170	0.9122640	0.9159050	0.9586520	0.8259540	6.8677E+01	6.6050E+00
α_2	1.81E-02	5.23E-02	4.84E-02	9.99E-02	9.92E-02	3.9364E+00	7.1346E+01
α_3	4.66E-03	2.62E-02	2.21E-02	6.17E-02	5.75E-02	1.9737E+00	7.3308E+01
α_4	1.58E-04	9.23E-03	5.39E-03	3.14E-02	1.73E-02	6.9487E-01	7.4587E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8965810	0.9350220	0.9372020	0.9660060	0.8455300	1.2393E+02	8.6123E+00
α_2	1.07E-02	3.06E-02	2.83E-02	5.85E-02	5.92E-02	4.0598E+00	1.2848E+02
α_3	5.50E-03	2.12E-02	1.88E-02	4.49E-02	5.57E-02	2.8061E+00	1.2974E+02
α_4	1.11E-03	1.06E-02	8.23E-03	2.80E-02	3.13E-02	1.4010E+00	1.3114E+02
α_5	9.30E-07	2.61E-03	7.89E-04	1.14E-02	8.31E-03	3.4538E-01	1.3220E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9059950	0.9397210	0.9415500	0.9671870	0.8607440	1.4994E+02	9.6179E+00
α_2	7.71E-03	2.34E-02	2.15E-02	4.58E-02	3.91E-02	3.7372E+00	1.5582E+02
α_3	4.62E-03	1.77E-02	1.57E-02	3.75E-02	4.39E-02	2.8253E+00	1.5673E+02
α_4	2.02E-03	1.20E-02	1.00E-02	2.87E-02	3.44E-02	1.9096E+00	1.5765E+02
α_5	2.22E-04	5.65E-03	3.76E-03	1.75E-02	1.77E-02	9.0130E-01	1.5866E+02
α_6	2.02E-08	1.53E-03	2.57E-04	7.47E-03	4.21E-03	2.4454E-01	1.5931E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.8620810	0.8229690	0.8259540	0.8455300	0.8607440
α_2	1.38E-01	1.39E-01	9.92E-02	5.92E-02	3.91E-02
α_3		3.85E-02	5.75E-02	5.57E-02	4.39E-02
α_4			1.73E-02	3.13E-02	3.44E-02
α_5				8.31E-03	1.77E-02
α_6					4.21E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	8.62E-01	8.23E-01	8.26E-01	8.46E-01	8.61E-01
Beta	1.38E-01	1.77E-01	1.74E-01	1.54E-01	1.39E-01
Gamma		2.17E-01	4.30E-01	6.17E-01	7.19E-01
Delta			2.31E-01	4.15E-01	5.62E-01
Epsilon				2.10E-01	3.89E-01
Mu					1.92E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	10.71	16.07	21.43	26.79	32.14
N_1	2.8333	1.7500	1.1111	0.9838	0.8623
N_2	2.1667	3.0000	2.7083	1.9456	1.4980
N_3		0.8333	1.5694	1.8287	1.6835
N_4			0.4722	1.0266	1.3174
N_5				0.2731	0.6791
N_6					0.1613

1.8.6.4 SERVICE WATER TSA PLUG ENVIRONMENTAL SPAR:TSA-EE-PG

System :	Circulating water system Normally operating service water Standby service water
Component :	Strainer
Failure Mode :	No flow/plugged
Component Group :	Traveling Screen
Prox. Cause :	Extreme environmental stress
Filter Indep. by Cause? :	True
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 26.00
Total Number of Common-Cause Failure Events: 17

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.5957860	0.7200570	0.7239210	0.8310990	0.6274990	2.7571E+01	1.0719E+01
α_2	1.69E-01	2.80E-01	2.76E-01	4.04E-01	3.73E-01	1.0719E+01	2.7571E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.6942740	0.7822590	0.7851460	0.8603790	0.6222440	5.1230E+01	1.4260E+01
α_2	4.82E-02	1.01E-01	9.74E-02	1.69E-01	1.67E-01	6.6453E+00	5.8845E+01
α_3	5.89E-02	1.16E-01	1.12E-01	1.87E-01	2.11E-01	7.6145E+00	5.7875E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.7305780	0.8031600	0.8054330	0.8679760	0.6189510	7.1644E+01	1.7559E+01
α_2	3.84E-02	7.92E-02	7.61E-02	1.31E-01	1.42E-01	7.0674E+00	8.2135E+01
α_3	3.20E-02	7.02E-02	6.70E-02	1.19E-01	1.42E-01	6.2603E+00	8.2942E+01
α_4	1.72E-02	4.74E-02	4.41E-02	8.91E-02	9.73E-02	4.2310E+00	8.4972E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8122630	0.8616100	0.8632530	0.9053520	0.6447630	1.2667E+02	2.0346E+01
α_2	1.78E-02	4.05E-02	3.84E-02	7.02E-02	8.11E-02	5.9523E+00	1.4106E+02
α_3	2.48E-02	5.05E-02	4.85E-02	8.32E-02	1.36E-01	7.4298E+00	1.3959E+02
α_4	1.33E-02	3.36E-02	3.15E-02	6.10E-02	9.65E-02	4.9411E+00	1.4207E+02
α_5	2.50E-03	1.38E-02	1.16E-02	3.23E-02	4.12E-02	2.0223E+00	1.4499E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8352680	0.8781980	0.8796440	0.9161990	0.6817480	1.5333E+02	2.1266E+01
α_2	6.04E-03	1.96E-02	1.78E-02	3.94E-02	2.23E-02	3.4272E+00	1.7117E+02
α_3	2.19E-02	4.41E-02	4.23E-02	7.22E-02	1.23E-01	7.6927E+00	1.6690E+02
α_4	1.48E-02	3.39E-02	3.21E-02	5.89E-02	9.97E-02	5.9133E+00	1.6868E+02
α_5	5.23E-03	1.81E-02	1.63E-02	3.72E-02	5.52E-02	3.1672E+00	1.7143E+02
α_6	3.67E-04	6.10E-03	4.35E-03	1.78E-02	1.84E-02	1.0657E+00	1.7353E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.6274990	0.6222440	0.6189510	0.6447630	0.6817480
α_2	3.73E-01	1.67E-01	1.42E-01	8.11E-02	2.23E-02
α_3		2.11E-01	1.42E-01	1.36E-01	1.23E-01
α_4			9.73E-02	9.65E-02	9.97E-02
α_5				4.12E-02	5.52E-02
α_6					1.84E-02

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	6.27E-01	6.22E-01	6.19E-01	6.45E-01	6.82E-01
Beta	3.73E-01	3.78E-01	3.81E-01	3.55E-01	3.18E-01
Gamma		5.58E-01	6.28E-01	7.72E-01	9.30E-01
Delta			4.06E-01	5.02E-01	5.85E-01
Epsilon				2.99E-01	4.25E-01
Mu					2.50E-01

Extreme Environmental Event CCF Distributions
SERVICE WATER TSA PLUG ENVIRONMENTAL SPAR:TSA-EE-PG

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	12.12	18.18	24.24	30.30	36.36
N_1	5.2048	3.4955	1.2679	0.2054	0.0300
N_2	10.2845	5.8116	5.8393	3.8381	1.1880
N_3		7.3473	5.8560	6.4524	6.5509
N_4			4.0083	4.5667	5.3211
N_5				1.9500	2.9450
N_6					0.9825

1.9 Heat Exchangers

1.9.1 PWR HEAT EXCHANGER LOSS OF HEAT TRANSFER

1.9.1.1 PWR RHR HEAT EXCHANGER PLUG/LOSS OF HEAT TRANSFER

System : Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component : Heat Exchanger
Failure Mode : High dP across filter
Loss of heat transfer capabilities in heat exchangers
No flow/plugged
Plant Type : PWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 1.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8534630	0.9631150	0.9845230	0.9999320	1.0000000	1.1346E+01	4.3452E-01
α_2	6.93E-05	3.69E-02	1.55E-02	1.47E-01	0.00E+00	4.3452E-01	1.1346E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9013740	0.9653330	0.9745650	0.9976900	1.0000000	3.0655E+01	1.1009E+00
α_2	8.40E-04	2.63E-02	1.71E-02	8.28E-02	0.00E+00	8.3366E-01	3.0922E+01
α_3	2.97E-07	8.41E-03	1.71E-03	3.99E-02	0.00E+00	2.6722E-01	3.1489E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9097630	0.9622110	0.9683190	0.9937520	1.0000000	4.7236E+01	1.8551E+00
α_2	2.08E-03	2.50E-02	1.89E-02	6.89E-02	0.00E+00	1.2281E+00	4.7863E+01
α_3	9.31E-06	8.24E-03	3.06E-03	3.40E-02	0.00E+00	4.0431E-01	4.8687E+01
α_4	1.96E-08	4.54E-03	6.23E-04	2.27E-02	0.00E+00	2.2267E-01	4.8868E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	1.10	1.10	1.10
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.9.2 Pooled Heat Exchanger Plugged or Failure to Transfer Heat

1.9.2.1 HEAT EXCHANGER PLUGGED ALL SYSTEMS NON ENVIRO SPAR:HTX-PG

Component :	Heat Exchanger
Failure Mode :	Loss of heat transfer capabilities in heat exchangers
Prox. Cause :	State of other component Design error or inadequacy Manufacturing error or inadequacy Construction installation error or inadequacy Setpoint drift Ambient environmental stress Inadequate procedure Inadequate maintenance Age or Wear Accidental human action Human action procedure Other Internal environment Internal to component; piece-part Unknown
Filter Indep. by Cause? :	True
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 19.70
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9001440	0.9749310	0.9895740	0.9999480	0.9994560	1.7042E+01	4.3822E-01
α_2	4.86E-05	2.51E-02	1.04E-02	9.99E-02	5.44E-04	4.3822E-01	1.7042E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9225300	0.9727850	0.9800580	0.9981650	0.9989500	3.9733E+01	1.1116E+00
α_2	6.83E-04	2.07E-02	1.35E-02	6.51E-02	1.04E-03	8.4426E-01	4.0000E+01
α_3	2.31E-07	6.54E-03	1.32E-03	3.10E-02	9.81E-06	2.6732E-01	4.0577E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9272430	0.9695270	0.9744660	0.9949130	0.9984530	5.9690E+01	1.8761E+00
α_2	1.74E-03	2.03E-02	1.54E-02	5.57E-02	1.51E-03	1.2486E+00	6.0317E+01
α_3	7.47E-06	6.58E-03	2.44E-03	2.71E-02	3.68E-05	4.0481E-01	6.1161E+01
α_4	1.56E-08	3.62E-03	4.95E-04	1.81E-02	0.00E+00	2.2267E-01	6.1343E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9994560	0.9989500	0.9984530
α_2	5.44E-04	1.04E-03	1.51E-03
α_3		9.81E-06	3.68E-05
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.99E-01	9.99E-01	9.98E-01
Beta	5.44E-04	1.05E-03	1.55E-03
Gamma		9.35E-03	2.38E-02
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	6.57	9.85	13.13
N_1	0.2260	0.3284	0.4242
N_2	0.0037	0.0106	0.0205
N_3		0.0001	0.0005
N_4			0.0000

1.9.3 Containment Spray Heat Exchanger

1.9.3.1 CONTAINMENT SPRAY HTX LOSS OF HEAT TRANSFER

System :	Containment spray recirculation
Component :	Heat Exchanger
Failure Mode :	Fail to Operate (General operation failure, rate based) Loss of heat transfer capabilities in heat exchangers No flow/plugged
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 3.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8778910	0.9693580	0.9872590	0.9999390	1.0000000	1.3746E+01	4.3452E-01
α_2	5.70E-05	3.06E-02	1.27E-02	1.22E-01	0.00E+00	4.3452E-01	1.3746E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	1.0000000
α_2	0.00E+00

MGL Parameter	CCCG=2
1-Beta	1.00E+00
Beta	0.00E+00

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	3.50
N_1	0.0000
N_2	0.0000

1.9.4 BWR Residual Heat Removal Heat Exchanger

1.9.4.1 BWR RHR HEAT EXCHANGER LOSS OF HEAT TRANSFER CAPABILITIES

System : Residual Heat Removal (LCI in BWRs; LPI in PWRs)
Component : Heat Exchanger
Failure Mode : High dP across filter
Loss of heat transfer capabilities in heat exchangers
No flow/plugged
Plant Type : BWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 2.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8636860	0.9657330	0.9856730	0.9999380	1.0000000	1.2246E+01	4.3452E-01
α_2	6.41E-05	3.43E-02	1.43E-02	1.36E-01	0.00E+00	4.3452E-01	1.2246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9040420	0.9662880	0.9752810	0.9977560	1.0000000	3.1555E+01	1.1009E+00
α_2	8.16E-04	2.55E-02	1.67E-02	8.05E-02	0.00E+00	8.3366E-01	3.1822E+01
α_3	2.88E-07	8.18E-03	1.66E-03	3.88E-02	0.00E+00	2.6722E-01	3.2389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9113590	0.9628920	0.9688970	0.9938680	1.0000000	4.8136E+01	1.8551E+00
α_2	2.04E-03	2.46E-02	1.86E-02	6.77E-02	0.00E+00	1.2281E+00	4.8763E+01
α_3	9.14E-06	8.09E-03	3.01E-03	3.34E-02	0.00E+00	4.0431E-01	4.9587E+01
α_4	1.93E-08	4.45E-03	6.12E-04	2.23E-02	0.00E+00	2.2267E-01	4.9768E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	2.00	2.00	2.00
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.9.5 BWR Isolation Condenser Heat Exchanger

1.9.5.1 ISO CONDENSER HEAT EXCHANGER PLUG/LOSS OF HEAT TRANSFER

System : Isolation condenser
Component : Heat Exchanger
Failure Mode : High dP across filter
Loss of heat transfer capabilities in heat exchangers
No flow/plugged
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 0.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8386830	0.9593170	0.9828300	0.9999250	0.0000000	1.0246E+01	4.3452E-01
α_2	7.70E-05	4.07E-02	1.72E-02	1.61E-01	0.00E+00	4.3452E-01	1.0246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8979020	0.9640890	0.9736330	0.9976040	0.0000000	2.9555E+01	1.1009E+00
α_2	8.71E-04	2.72E-02	1.78E-02	8.57E-02	0.00E+00	8.3366E-01	2.9822E+01
α_3	3.08E-07	8.72E-03	1.77E-03	4.13E-02	0.00E+00	2.6722E-01	3.0389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9077330	0.9613450	0.9675780	0.9936050	0.0000000	4.6136E+01	1.8551E+00
α_2	2.13E-03	2.56E-02	1.93E-02	7.04E-02	0.00E+00	1.2281E+00	4.6763E+01
α_3	9.52E-06	8.42E-03	3.13E-03	3.48E-02	0.00E+00	4.0431E-01	4.7587E+01
α_4	2.01E-08	4.64E-03	6.37E-04	2.32E-02	0.00E+00	2.2267E-01	4.7768E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.0000000	0.0000000	0.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	0.00E+00	0.00E+00	0.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	0.00	0.00	0.00
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.9.6 Component Cooling Heat Exchanger

1.9.6.1 CCW HEAT EXCHANGER LOSS OF HEAT TRANSFER SPAR: CCW-HTX-PG

System :	Component cooling water
Component :	Heat Exchanger
Failure Mode :	Fail to Operate (General operation failure, rate based) Loss of heat transfer capabilities in heat exchangers No flow/plugged
Prox. Cause :	State of other component Design error or inadequacy Manufacturing error or inadequacy Construction installation error or inadequacy Setpoint drift Ambient environmental stress Inadequate procedure Inadequate maintenance Age or Wear Accidental human action Human action procedure Other Internal environment Internal to component; piece-part Unknown
Filter Indep. by Cause? :	True
Start Date :	1998/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 11.60
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8821540	0.9703510	0.9875850	0.9999380	0.9990970	1.4342E+01	4.3822E-01
α_2	5.80E-05	2.96E-02	1.24E-02	1.18E-01	9.03E-04	4.3822E-01	1.4342E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9141370	0.9697900	0.9778230	0.9979520	0.9982570	3.5683E+01	1.1116E+00
α_2	7.60E-04	2.29E-02	1.50E-02	7.21E-02	1.73E-03	8.4426E-01	3.5950E+01
α_3	2.56E-07	7.27E-03	1.47E-03	3.45E-02	1.63E-05	2.6732E-01	3.6527E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9203610	0.9665980	0.9719770	0.9944120	0.9974310	5.4290E+01	1.8761E+00
α_2	1.91E-03	2.22E-02	1.69E-02	6.10E-02	2.51E-03	1.2486E+00	5.4917E+01
α_3	8.20E-06	7.21E-03	2.68E-03	2.97E-02	6.12E-05	4.0481E-01	5.5761E+01
α_4	1.71E-08	3.96E-03	5.44E-04	1.99E-02	0.00E+00	2.2267E-01	5.5943E+01

ALPHA FACTOR and MGL PARAMETERS

CCW HEAT EXCHANGER LOSS OF HEAT TRANSFER SPAR: CCW-HTX-PG

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9990970	0.9982570	0.9974310
α_2	9.03E-04	1.73E-03	2.51E-03
α_3		1.63E-05	6.12E-05
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.99E-01	9.98E-01	9.97E-01
Beta	9.03E-04	1.74E-03	2.57E-03
Gamma		9.35E-03	2.38E-02
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	3.87	5.80	7.73
N_1	0.2260	0.3284	0.4242
N_2	0.0037	0.0106	0.0205
N_3		0.0001	0.0005
N_4			0.0000

1.10 Safety and Relief Valves

1.10.1 Pooled Safety Valves

1.10.1.1 SAFETY VALVES (DIRECT ACTING) FAIL TO OPEN ALL SYS

Component :	Safety Valve (Single Acting)
Failure Mode :	Fail to open on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 3.50
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8423950	0.9583570	0.9802420	0.9998360	0.9495070	1.1344E+01	4.9292E-01
α_2	1.62E-04	4.16E-02	1.98E-02	1.58E-01	5.05E-02	4.9292E-01	1.1344E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8942300	0.9609470	0.9700340	0.9965330	0.9027380	3.1048E+01	1.2618E+00
α_2	1.57E-03	3.06E-02	2.15E-02	9.05E-02	9.30E-02	9.8746E-01	3.1322E+01
α_3	3.92E-07	8.49E-03	1.81E-03	3.99E-02	4.29E-03	2.7432E-01	3.2035E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9023490	0.9570830	0.9630370	0.9914410	0.8600240	4.7949E+01	2.1501E+00
α_2	3.57E-03	2.99E-02	2.39E-02	7.67E-02	1.27E-01	1.4962E+00	4.8603E+01
α_3	1.46E-05	8.60E-03	3.43E-03	3.47E-02	1.25E-02	4.3071E-01	4.9668E+01
α_4	1.98E-08	4.45E-03	6.15E-04	2.23E-02	2.37E-04	2.2317E-01	4.9876E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9253440	0.9609850	0.9639570	0.9864580	0.8210590	9.8224E+01	3.9878E+00
α_2	5.69E-03	2.45E-02	2.14E-02	5.36E-02	1.54E-01	2.5006E+00	9.9711E+01
α_3	5.76E-04	1.02E-02	7.19E-03	2.99E-02	2.40E-02	1.0378E+00	1.0117E+02
α_4	2.56E-06	3.69E-03	1.25E-03	1.56E-02	1.07E-03	3.7709E-01	1.0183E+02
α_5	5.84E-21	7.07E-04	4.00E-07	4.09E-03	0.00E+00	7.2277E-02	1.0214E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9283460	0.9605700	0.9630210	0.9844110	0.7873710	1.1922E+02	4.8939E+00
α_2	5.59E-03	2.20E-02	1.95E-02	4.71E-02	1.72E-01	2.7363E+00	1.2138E+02
α_3	8.60E-04	1.01E-02	7.60E-03	2.78E-02	3.80E-02	1.2517E+00	1.2286E+02
α_4	4.59E-05	4.84E-03	2.56E-03	1.74E-02	2.83E-03	6.0042E-01	1.2351E+02
α_5	7.49E-09	1.79E-03	2.43E-04	8.97E-03	0.00E+00	2.2220E-01	1.2389E+02
α_6	1.14E-18	6.71E-04	1.17E-06	3.91E-03	0.00E+00	8.3237E-02	1.2403E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9379550	0.9626850	0.9642650	0.9820090	0.7583860	1.8651E+02	7.2294E+00
α_2	6.17E-03	1.90E-02	1.74E-02	3.74E-02	1.82E-01	3.6799E+00	1.9006E+02
α_3	1.45E-03	9.31E-03	7.69E-03	2.27E-02	5.33E-02	1.8043E+00	1.9194E+02
α_4	2.74E-04	5.20E-03	3.63E-03	1.55E-02	5.91E-03	1.0081E+00	1.9273E+02
α_5	1.32E-05	2.69E-03	1.28E-03	1.02E-02	0.00E+00	5.2177E-01	1.9322E+02
α_6	3.47E-10	9.61E-04	8.21E-05	5.05E-03	0.00E+00	1.8628E-01	1.9355E+02
α_7	0.00E+00	1.50E-04	1.31E-13	5.65E-04	0.00E+00	2.9071E-02	1.9371E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9410180	0.9633880	0.9647230	0.9811930	0.7340250	2.2135E+02	8.4121E+00
α_2	6.02E-03	1.75E-02	1.61E-02	3.36E-02	1.86E-01	4.0111E+00	2.2575E+02
α_3	1.53E-03	8.64E-03	7.26E-03	2.05E-02	6.88E-02	1.9846E+00	2.2778E+02
α_4	3.92E-04	5.16E-03	3.81E-03	1.45E-02	1.08E-02	1.1850E+00	2.2858E+02
α_5	5.61E-05	3.08E-03	1.81E-03	1.04E-02	0.00E+00	7.0833E-01	2.2905E+02
α_6	9.04E-07	1.60E-03	5.23E-04	6.83E-03	0.00E+00	3.6696E-01	2.2940E+02
α_7	7.09E-14	5.35E-04	9.63E-06	3.05E-03	0.00E+00	1.2297E-01	2.2964E+02
α_8	1.33E-42	1.44E-04	2.05E-12	6.09E-04	0.00E+00	3.3124E-02	2.2973E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9495070	0.9027380	0.8600240	0.8210590	0.7873710	0.7583860	0.7340250
α_2	5.05E-02	9.30E-02	1.27E-01	1.54E-01	1.72E-01	1.82E-01	1.86E-01
α_3		4.29E-03	1.25E-02	2.40E-02	3.80E-02	5.33E-02	6.88E-02
α_4			2.37E-04	1.07E-03	2.83E-03	5.91E-03	1.08E-02
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.50E-01	9.03E-01	8.60E-01	8.21E-01	7.87E-01	7.58E-01	7.34E-01
Beta	5.05E-02	9.73E-02	1.40E-01	1.79E-01	2.13E-01	2.42E-01	2.66E-01
Gamma		4.41E-02	9.12E-02	1.40E-01	1.92E-01	2.45E-01	2.99E-01
Delta			1.86E-02	4.28E-02	6.94E-02	9.98E-02	1.35E-01
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	0.44	0.66	0.88	1.09	1.31	1.53	1.75
N_1	0.6582	0.8334	0.9325	0.9725	0.9681	0.9321	0.8748
N_2	0.0584	0.1538	0.2681	0.3864	0.4971	0.5921	0.6664
N_3		0.0071	0.0264	0.0604	0.1099	0.1731	0.2462
N_4			0.0005	0.0027	0.0082	0.0192	0.0385
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.10.1.2 SAFETY VALVES (DIRECT ACTING) FAIL TO CLOSE ALL SYS

Component :	Safety Valve (Single Acting)
Failure Mode :	Fail to close (reseat) on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 7.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8520040	0.9624790	0.9839450	0.9999230	0.9926000	1.1359E+01	4.4282E-01
α_2	7.92E-05	3.75E-02	1.61E-02	1.48E-01	7.40E-03	4.4282E-01	1.1359E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9016600	0.9651600	0.9742450	0.9975600	0.9849400	3.1190E+01	1.1259E+00
α_2	9.29E-04	2.66E-02	1.76E-02	8.29E-02	1.51E-02	8.5866E-01	3.1457E+01
α_3	2.91E-07	8.27E-03	1.68E-03	3.92E-02	0.00E+00	2.6722E-01	3.2049E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9101260	0.9620430	0.9680200	0.9935000	0.9772730	4.8286E+01	1.9051E+00
α_2	2.29E-03	2.55E-02	1.95E-02	6.92E-02	2.27E-02	1.2781E+00	4.8913E+01
α_3	9.10E-06	8.06E-03	3.00E-03	3.33E-02	0.00E+00	4.0431E-01	4.9787E+01
α_4	1.92E-08	4.44E-03	6.09E-04	2.22E-02	0.00E+00	2.2267E-01	4.9968E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9305070	0.9646440	0.9676270	0.9885670	0.9695050	9.8809E+01	3.6215E+00
α_2	4.33E-03	2.15E-02	1.84E-02	4.90E-02	3.05E-02	2.1975E+00	1.0023E+02
α_3	4.66E-04	9.54E-03	6.60E-03	2.87E-02	0.00E+00	9.7738E-01	1.0145E+02
α_4	2.40E-06	3.66E-03	1.23E-03	1.55E-02	0.00E+00	3.7439E-01	1.0206E+02
α_5	5.83E-21	7.06E-04	3.99E-07	4.09E-03	0.00E+00	7.2277E-02	1.0236E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9339130	0.9646220	0.9670870	0.9869070	0.9615980	1.2007E+02	4.4037E+00
α_2	4.15E-03	1.90E-02	1.65E-02	4.24E-02	3.84E-02	2.3642E+00	1.2211E+02
α_3	6.46E-04	9.17E-03	6.71E-03	2.61E-02	0.00E+00	1.1418E+00	1.2333E+02
α_4	4.26E-05	4.76E-03	2.49E-03	1.72E-02	0.00E+00	5.9222E-01	1.2388E+02
α_5	7.47E-09	1.79E-03	2.42E-04	8.94E-03	0.00E+00	2.2220E-01	1.2425E+02
α_6	1.13E-18	6.69E-04	1.17E-06	3.90E-03	0.00E+00	8.3237E-02	1.2439E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9421820	0.9659200	0.9675070	0.9842320	0.9534570	1.8763E+02	6.6200E+00
α_2	4.96E-03	1.68E-02	1.52E-02	3.42E-02	4.65E-02	3.2628E+00	1.9099E+02
α_3	1.13E-03	8.40E-03	6.78E-03	2.12E-02	0.00E+00	1.6312E+00	1.9262E+02
α_4	2.55E-04	5.09E-03	3.52E-03	1.53E-02	0.00E+00	9.8887E-01	1.9326E+02
α_5	1.32E-05	2.69E-03	1.27E-03	1.02E-02	0.00E+00	5.2177E-01	1.9373E+02
α_6	3.46E-10	9.59E-04	8.19E-05	5.03E-03	0.00E+00	1.8628E-01	1.9406E+02
α_7	0.00E+00	1.50E-04	1.31E-13	5.63E-04	0.00E+00	2.9071E-02	1.9422E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9451620	0.9666130	0.9679560	0.9834840	0.9453190	2.2276E+02	7.6943E+00
α_2	4.93E-03	1.55E-02	1.41E-02	3.08E-02	5.47E-02	3.5780E+00	2.2688E+02
α_3	1.12E-03	7.54E-03	6.17E-03	1.87E-02	0.00E+00	1.7384E+00	2.2872E+02
α_4	3.52E-04	4.97E-03	3.64E-03	1.42E-02	0.00E+00	1.1465E+00	2.2931E+02
α_5	5.60E-05	3.07E-03	1.81E-03	1.04E-02	0.00E+00	7.0833E-01	2.2975E+02
α_6	9.01E-07	1.59E-03	5.21E-04	6.81E-03	0.00E+00	3.6696E-01	2.3009E+02
α_7	7.07E-14	5.34E-04	9.60E-06	3.04E-03	0.00E+00	1.2297E-01	2.3033E+02
α_8	1.32E-42	1.44E-04	2.05E-12	6.07E-04	0.00E+00	3.3124E-02	2.3042E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9926000	0.9849400	0.9772730	0.9695050	0.9615980	0.9534570	0.9453190
α_2	7.40E-03	1.51E-02	2.27E-02	3.05E-02	3.84E-02	4.65E-02	5.47E-02
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.93E-01	9.85E-01	9.77E-01	9.70E-01	9.62E-01	9.53E-01	9.45E-01
Beta	7.40E-03	1.51E-02	2.27E-02	3.05E-02	3.84E-02	4.65E-02	5.47E-02
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	0.88	1.31	1.75	2.19	2.63	3.06	3.50
N_1	0.2333	0.3250	0.4000	0.4583	0.5000	0.5250	0.5333
N_2	0.0083	0.0250	0.0500	0.0833	0.1250	0.1750	0.2333
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.10.2 PWR Steam Generator Safety Valves

1.10.2.1 PWR MAIN STEAM CODE SAFETIES FAIL TO OPEN

System : Main steam
Component : Safety Valve (Single Acting)
Failure Mode : Fail to open on demand
Plant Type : PWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 1.00
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8382550	0.9572370	0.9796800	0.9998310	0.9310180	1.1034E+01	4.9292E-01
α_2	1.67E-04	4.28E-02	2.03E-02	1.62E-01	6.90E-02	4.9292E-01	1.1034E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8927010	0.9603710	0.9695830	0.9964800	0.8641390	3.0578E+01	1.2618E+00
α_2	1.59E-03	3.10E-02	2.18E-02	9.18E-02	1.30E-01	9.8746E-01	3.0852E+01
α_3	3.97E-07	8.62E-03	1.83E-03	4.05E-02	6.00E-03	2.7432E-01	3.1565E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9011290	0.9565370	0.9625600	0.9913290	0.8003380	4.7319E+01	2.1501E+00
α_2	3.62E-03	3.02E-02	2.42E-02	7.77E-02	1.81E-01	1.4962E+00	4.7973E+01
α_3	1.48E-05	8.71E-03	3.47E-03	3.51E-02	1.79E-02	4.3071E-01	4.9038E+01
α_4	2.01E-08	4.51E-03	6.23E-04	2.26E-02	3.38E-04	2.2317E-01	4.9246E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9310180	0.8641390	0.8003380
α_2	6.90E-02	1.30E-01	1.81E-01
α_3		6.00E-03	1.79E-02
α_4			3.38E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.31E-01	8.64E-01	8.00E-01
Beta	6.90E-02	1.36E-01	2.00E-01
Gamma		4.41E-02	9.12E-02
Delta			1.86E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	0.13	0.19	0.25
N_1	0.6582	0.8334	0.9325
N_2	0.0584	0.1538	0.2681
N_3		0.0071	0.0264
N_4			0.0005

1.10.2.2 PWR MAIN STEAM CODE SAFETIES FAIL TO CLOSE

System :	Main steam
Component :	Safety Valve (Single Acting)
Failure Mode :	Fail to close (reseat) on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 6.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8503880	0.9620610	0.9837560	0.9999220	0.9916300	1.1229E+01	4.4282E-01
α_2	8.01E-05	3.79E-02	1.62E-02	1.50E-01	8.37E-03	4.4282E-01	1.1229E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9011190	0.9649650	0.9740980	0.9975450	0.9831080	3.1010E+01	1.1259E+00
α_2	9.34E-04	2.67E-02	1.77E-02	8.33E-02	1.69E-02	8.5866E-01	3.1277E+01
α_3	2.93E-07	8.32E-03	1.69E-03	3.94E-02	0.00E+00	2.6722E-01	3.1869E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9096840	0.9618530	0.9678530	0.9934660	0.9743590	4.8036E+01	1.9051E+00
α_2	2.30E-03	2.56E-02	1.96E-02	6.95E-02	2.56E-02	1.2781E+00	4.8663E+01
α_3	9.14E-06	8.10E-03	3.01E-03	3.34E-02	0.00E+00	4.0431E-01	4.9537E+01
α_4	1.93E-08	4.46E-03	6.12E-04	2.23E-02	0.00E+00	2.2267E-01	4.9718E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9302990	0.9645370	0.9675290	0.9885310	0.9656010	9.8499E+01	3.6215E+00
α_2	4.34E-03	2.15E-02	1.85E-02	4.91E-02	3.44E-02	2.1975E+00	9.9923E+01
α_3	4.68E-04	9.57E-03	6.62E-03	2.88E-02	0.00E+00	9.7738E-01	1.0114E+02
α_4	2.41E-06	3.67E-03	1.24E-03	1.56E-02	0.00E+00	3.7439E-01	1.0175E+02
α_5	5.85E-21	7.08E-04	4.00E-07	4.10E-03	0.00E+00	7.2277E-02	1.0205E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9337130	0.9645130	0.9669850	0.9868660	0.9565220	1.1969E+02	4.4037E+00
α_2	4.16E-03	1.91E-02	1.65E-02	4.26E-02	4.35E-02	2.3642E+00	1.2173E+02
α_3	6.48E-04	9.20E-03	6.73E-03	2.62E-02	0.00E+00	1.1418E+00	1.2295E+02
α_4	4.27E-05	4.77E-03	2.50E-03	1.72E-02	0.00E+00	5.9222E-01	1.2350E+02
α_5	7.49E-09	1.79E-03	2.43E-04	8.97E-03	0.00E+00	2.2220E-01	1.2387E+02
α_6	1.14E-18	6.71E-04	1.17E-06	3.92E-03	0.00E+00	8.3237E-02	1.2401E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9420580	0.9658460	0.9674360	0.9841980	0.9474470	1.8721E+02	6.6200E+00
α_2	4.97E-03	1.68E-02	1.52E-02	3.43E-02	5.26E-02	3.2628E+00	1.9057E+02
α_3	1.13E-03	8.42E-03	6.80E-03	2.12E-02	0.00E+00	1.6312E+00	1.9220E+02
α_4	2.56E-04	5.10E-03	3.53E-03	1.53E-02	0.00E+00	9.8887E-01	1.9284E+02
α_5	1.32E-05	2.69E-03	1.27E-03	1.02E-02	0.00E+00	5.2177E-01	1.9331E+02
α_6	3.47E-10	9.61E-04	8.21E-05	5.04E-03	0.00E+00	1.8628E-01	1.9364E+02
α_7	0.00E+00	1.50E-04	1.31E-13	5.65E-04	0.00E+00	2.9071E-02	1.9380E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9450440	0.9665400	0.9678870	0.9834470	0.9380610	2.2226E+02	7.6943E+00
α_2	4.94E-03	1.56E-02	1.42E-02	3.09E-02	6.19E-02	3.5780E+00	2.2638E+02
α_3	1.12E-03	7.56E-03	6.19E-03	1.87E-02	0.00E+00	1.7384E+00	2.2822E+02
α_4	3.53E-04	4.99E-03	3.64E-03	1.42E-02	0.00E+00	1.1465E+00	2.2881E+02
α_5	5.61E-05	3.08E-03	1.81E-03	1.04E-02	0.00E+00	7.0833E-01	2.2925E+02
α_6	9.03E-07	1.60E-03	5.22E-04	6.83E-03	0.00E+00	3.6696E-01	2.2959E+02
α_7	7.08E-14	5.35E-04	9.62E-06	3.04E-03	0.00E+00	1.2297E-01	2.2983E+02
α_8	1.33E-42	1.44E-04	2.05E-12	6.09E-04	0.00E+00	3.3124E-02	2.2992E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9916300	0.9831080	0.9743590	0.9656010	0.9565220	0.9474470	0.9380610
α_2	8.37E-03	1.69E-02	2.56E-02	3.44E-02	4.35E-02	5.26E-02	6.19E-02
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.92E-01	9.83E-01	9.74E-01	9.66E-01	9.57E-01	9.47E-01	9.38E-01
Beta	8.37E-03	1.69E-02	2.56E-02	3.44E-02	4.35E-02	5.26E-02	6.19E-02
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	0.75	1.13	1.50	1.88	2.25	2.63	3.00
N_1	0.2333	0.3250	0.4000	0.4583	0.5000	0.5250	0.5333
N_2	0.0083	0.0250	0.0500	0.0833	0.1250	0.1750	0.2333
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.10.3 BWR Safety Relief Valves

1.10.3.1 SAFETY RELIEF VALVE FAIL TO OPEN SPAR: SRV-CC

Component : Safety Relief Valve (Dual Actuation)
Failure Mode : Fail to open on demand
Plant Type : BWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 22.00
Total Number of Common-Cause Failure Events: 6

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8822100	0.9669040	0.9821450	0.9996980	0.9782140	1.7255E+01	5.9062E-01
α_2	3.04E-04	3.31E-02	1.79E-02	1.18E-01	2.18E-02	5.9062E-01	1.7255E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9048570	0.9624200	0.9696450	0.9952230	0.9575650	3.9637E+01	1.5477E+00
α_2	2.75E-03	3.08E-02	2.36E-02	8.37E-02	4.14E-02	1.2698E+00	3.9915E+01
α_3	3.53E-07	6.75E-03	1.46E-03	3.16E-02	1.02E-03	2.7792E-01	4.0907E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9068880	0.9561670	0.9610150	0.9888550	0.9381020	5.9043E+01	2.7067E+00
α_2	6.13E-03	3.30E-02	2.81E-02	7.67E-02	5.88E-02	2.0377E+00	5.9712E+01
α_3	1.51E-05	7.22E-03	2.98E-03	2.88E-02	3.03E-03	4.4601E-01	6.1304E+01
α_4	1.59E-08	3.61E-03	4.96E-04	1.81E-02	2.18E-05	2.2297E-01	6.1527E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9248030	0.9587780	0.9613770	0.9838600	0.9249210	1.1178E+02	4.8059E+00
α_2	8.19E-03	2.78E-02	2.51E-02	5.64E-02	6.65E-02	3.2373E+00	1.1335E+02
α_3	6.50E-04	9.61E-03	6.99E-03	2.75E-02	8.47E-03	1.1204E+00	1.1547E+02
α_4	2.18E-06	3.22E-03	1.09E-03	1.37E-02	8.88E-05	3.7589E-01	1.1621E+02
α_5	5.12E-21	6.20E-04	3.51E-07	3.59E-03	0.00E+00	7.2277E-02	1.1651E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9264460	0.9574880	0.9596330	0.9811950	0.9135520	1.3513E+02	5.9997E+00
α_2	8.45E-03	2.60E-02	2.38E-02	5.11E-02	7.18E-02	3.6688E+00	1.3746E+02
α_3	1.09E-03	1.01E-02	7.87E-03	2.66E-02	1.41E-02	1.4216E+00	1.3971E+02
α_4	4.16E-05	4.28E-03	2.27E-03	1.53E-02	5.83E-04	6.0382E-01	1.4053E+02
α_5	6.58E-09	1.57E-03	2.13E-04	7.89E-03	0.00E+00	2.2220E-01	1.4091E+02
α_6	9.99E-19	5.90E-04	1.03E-06	3.44E-03	0.00E+00	8.3237E-02	1.4105E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9352050	0.9595250	0.9609560	0.9789680	0.9041910	2.0472E+02	8.6356E+00
α_2	8.70E-03	2.24E-02	2.10E-02	4.12E-02	7.44E-02	4.7893E+00	2.0857E+02
α_3	1.85E-03	9.79E-03	8.31E-03	2.28E-02	2.00E-02	2.0887E+00	2.1127E+02
α_4	2.58E-04	4.78E-03	3.35E-03	1.42E-02	1.33E-03	1.0193E+00	2.1234E+02
α_5	1.22E-05	2.45E-03	1.16E-03	9.26E-03	5.25E-05	5.2297E-01	2.1283E+02
α_6	3.15E-10	8.73E-04	7.45E-05	4.58E-03	0.00E+00	1.8628E-01	2.1317E+02
α_7	0.00E+00	1.36E-04	1.19E-13	5.13E-04	0.00E+00	2.9071E-02	2.1333E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9378770	0.9600060	0.9612210	0.9779950	0.8984690	2.4187E+02	1.0076E+01
α_2	8.38E-03	2.06E-02	1.94E-02	3.72E-02	7.19E-02	5.1966E+00	2.4675E+02
α_3	2.17E-03	9.68E-03	8.42E-03	2.15E-02	2.72E-02	2.4389E+00	2.4951E+02
α_4	3.76E-04	4.78E-03	3.55E-03	1.34E-02	2.27E-03	1.2051E+00	2.5074E+02
α_5	5.26E-05	2.83E-03	1.67E-03	9.55E-03	1.63E-04	7.1253E-01	2.5123E+02
α_6	8.28E-07	1.46E-03	4.77E-04	6.23E-03	7.76E-06	3.6716E-01	2.5158E+02
α_7	6.46E-14	4.88E-04	8.78E-06	2.78E-03	0.00E+00	1.2297E-01	2.5182E+02
α_8	1.21E-42	1.31E-04	1.87E-12	5.56E-04	0.00E+00	3.3124E-02	2.5191E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9782140	0.9575650	0.9381020	0.9249210	0.9135520	0.9041910	0.8984690
α_2	2.18E-02	4.14E-02	5.88E-02	6.65E-02	7.18E-02	7.44E-02	7.19E-02
α_3		1.02E-03	3.03E-03	8.47E-03	1.41E-02	2.00E-02	2.72E-02
α_4			2.18E-05	8.88E-05	5.83E-04	1.33E-03	2.27E-03
α_5				0.00E+00	0.00E+00	5.25E-05	1.63E-04
α_6					0.00E+00	0.00E+00	7.76E-06
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.78E-01	9.58E-01	9.38E-01	9.25E-01	9.14E-01	9.04E-01	8.98E-01
Beta	2.18E-02	4.24E-02	6.19E-02	7.51E-02	8.64E-02	9.58E-02	1.02E-01
Gamma		2.39E-02	4.93E-02	1.14E-01	1.69E-01	2.23E-01	2.92E-01
Delta			7.14E-03	1.04E-02	3.98E-02	6.46E-02	8.25E-02
Epsilon				0.00E+00	0.00E+00	3.80E-02	6.98E-02
Mu					0.00E+00	0.00E+00	4.55E-02
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	5.07	7.61	10.15	12.69	15.22	17.76	20.30
N_1	1.9389	2.4723	2.7566	2.9259	2.9670	2.9137	2.8443
N_2	0.1561	0.4361	0.8096	1.1231	1.4296	1.7015	1.8519
N_3		0.0107	0.0417	0.1430	0.2798	0.4575	0.7005
N_4			0.0003	0.0015	0.0116	0.0304	0.0586
N_5				0.0000	0.0000	0.0012	0.0042
N_6					0.0000	0.0000	0.0002
N_7						0.0000	0.0000
N_8							0.0000

1.10.3.2 SAFETY RELIEF VALVE FAIL TO CLOSE SPAR: SRV-OO

Component : Safety Relief Valve (Dual Actuation)
Failure Mode : Fail to close (reseat) on demand
Plant Type : BWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 7.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9023290	0.9755620	0.9899320	0.9999510	1.0000000	1.7346E+01	4.3452E-01
α_2	4.50E-05	2.44E-02	1.01E-02	9.77E-02	0.00E+00	4.3452E-01	1.7346E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9168040	0.9708420	0.9786790	0.9980720	1.0000000	3.6655E+01	1.1009E+00
α_2	7.03E-04	2.21E-02	1.44E-02	6.98E-02	0.00E+00	8.3366E-01	3.6922E+01
α_3	2.49E-07	7.08E-03	1.43E-03	3.36E-02	0.00E+00	2.6722E-01	3.7489E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9194410	0.9663270	0.9718060	0.9944490	1.0000000	5.3236E+01	1.8551E+00
α_2	1.85E-03	2.23E-02	1.68E-02	6.15E-02	0.00E+00	1.2281E+00	5.3863E+01
α_3	8.28E-06	7.34E-03	2.73E-03	3.03E-02	0.00E+00	4.0431E-01	5.4687E+01
α_4	1.75E-08	4.04E-03	5.54E-04	2.02E-02	0.00E+00	2.2267E-01	5.4868E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9344190	0.9668700	0.9697430	0.9894840	1.0000000	1.0326E+02	3.5382E+00
α_2	3.81E-03	1.98E-02	1.69E-02	4.57E-02	0.00E+00	2.1142E+00	1.0468E+02
α_3	4.47E-04	9.15E-03	6.32E-03	2.75E-02	0.00E+00	9.7738E-01	1.0582E+02
α_4	2.31E-06	3.51E-03	1.18E-03	1.49E-02	0.00E+00	3.7439E-01	1.0642E+02
α_5	5.59E-21	6.77E-04	3.83E-07	3.92E-03	0.00E+00	7.2277E-02	1.0673E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9372120	0.9666560	0.9690580	0.9878980	1.0000000	1.2404E+02	4.2787E+00
α_2	3.59E-03	1.75E-02	1.50E-02	3.97E-02	0.00E+00	2.2392E+00	1.2608E+02
α_3	6.27E-04	8.90E-03	6.51E-03	2.53E-02	0.00E+00	1.1418E+00	1.2718E+02
α_4	4.13E-05	4.62E-03	2.42E-03	1.66E-02	0.00E+00	5.9222E-01	1.2773E+02
α_5	7.24E-09	1.73E-03	2.35E-04	8.68E-03	0.00E+00	2.2220E-01	1.2810E+02
α_6	1.10E-18	6.49E-04	1.13E-06	3.79E-03	0.00E+00	8.3237E-02	1.2824E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9443070	0.9673830	0.9689520	0.9851090	1.0000000	1.9115E+02	6.4450E+00
α_2	4.40E-03	1.56E-02	1.40E-02	3.23E-02	0.00E+00	3.0878E+00	1.9451E+02
α_3	1.11E-03	8.26E-03	6.67E-03	2.08E-02	0.00E+00	1.6312E+00	1.9596E+02
α_4	2.51E-04	5.00E-03	3.46E-03	1.50E-02	0.00E+00	9.8887E-01	1.9661E+02
α_5	1.30E-05	2.64E-03	1.25E-03	9.98E-03	0.00E+00	5.2177E-01	1.9707E+02
α_6	3.40E-10	9.43E-04	8.05E-05	4.95E-03	0.00E+00	1.8628E-01	1.9741E+02
α_7	0.00E+00	1.47E-04	1.29E-13	5.54E-04	0.00E+00	2.9071E-02	1.9757E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9471070	0.9680190	0.9693510	0.9843930	1.0000000	2.2583E+02	7.4610E+00
α_2	4.31E-03	1.43E-02	1.30E-02	2.90E-02	0.00E+00	3.3447E+00	2.2995E+02
α_3	1.10E-03	7.45E-03	6.10E-03	1.84E-02	0.00E+00	1.7384E+00	2.3155E+02
α_4	3.48E-04	4.91E-03	3.59E-03	1.40E-02	0.00E+00	1.1465E+00	2.3214E+02
α_5	5.53E-05	3.04E-03	1.78E-03	1.03E-02	0.00E+00	7.0833E-01	2.3258E+02
α_6	8.90E-07	1.57E-03	5.15E-04	6.73E-03	0.00E+00	3.6696E-01	2.3292E+02
α_7	6.98E-14	5.27E-04	9.48E-06	3.00E-03	0.00E+00	1.2297E-01	2.3317E+02
α_8	1.31E-42	1.42E-04	2.02E-12	6.00E-04	0.00E+00	3.3124E-02	2.3326E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	7.10	7.10	7.10	7.10	7.10	7.10	7.10
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.10.4 PWR Pressurizer Safety Valve

1.10.4.1 PWR PRESSURIZER CODE SAFETIES FAIL TO OPEN

System : Reactor coolant
Component : Safety Valve (Single Acting)
Failure Mode : Fail to open on demand
Plant Type : PWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 2.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8687700	0.9670330	0.9862440	0.9999400	1.0000000	1.2746E+01	4.3452E-01
α_2	6.16E-05	3.30E-02	1.38E-02	1.31E-01	0.00E+00	4.3452E-01	1.2746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9054640	0.9667970	0.9756610	0.9977910	1.0000000	3.2055E+01	1.1009E+00
α_2	8.04E-04	2.51E-02	1.64E-02	7.93E-02	0.00E+00	8.3366E-01	3.2322E+01
α_3	2.84E-07	8.06E-03	1.63E-03	3.82E-02	0.00E+00	2.6722E-01	3.2889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9122220	0.9632590	0.9692100	0.9939300	1.0000000	4.8636E+01	1.8551E+00
α_2	2.02E-03	2.43E-02	1.84E-02	6.70E-02	0.00E+00	1.2281E+00	4.9263E+01
α_3	9.04E-06	8.01E-03	2.98E-03	3.31E-02	0.00E+00	4.0431E-01	5.0087E+01
α_4	1.91E-08	4.41E-03	6.05E-04	2.21E-02	0.00E+00	2.2267E-01	5.0268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9315060	0.9653790	0.9683770	0.9890030	1.0000000	9.8661E+01	3.5382E+00
α_2	3.99E-03	2.07E-02	1.76E-02	4.78E-02	0.00E+00	2.1142E+00	1.0009E+02
α_3	4.67E-04	9.56E-03	6.61E-03	2.87E-02	0.00E+00	9.7738E-01	1.0122E+02
α_4	2.41E-06	3.66E-03	1.23E-03	1.56E-02	0.00E+00	3.7439E-01	1.0182E+02
α_5	5.84E-21	7.07E-04	4.00E-07	4.10E-03	0.00E+00	7.2277E-02	1.0213E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9349050	0.9654160	0.9678990	0.9874410	1.0000000	1.1944E+02	4.2787E+00
α_2	3.72E-03	1.81E-02	1.56E-02	4.11E-02	0.00E+00	2.2392E+00	1.2148E+02
α_3	6.50E-04	9.23E-03	6.75E-03	2.63E-02	0.00E+00	1.1418E+00	1.2258E+02
α_4	4.28E-05	4.79E-03	2.51E-03	1.73E-02	0.00E+00	5.9222E-01	1.2313E+02
α_5	7.51E-09	1.80E-03	2.44E-04	9.00E-03	0.00E+00	2.2220E-01	1.2350E+02
α_6	1.14E-18	6.73E-04	1.18E-06	3.93E-03	0.00E+00	8.3237E-02	1.2364E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9429930	0.9666050	0.9682080	0.9847450	1.0000000	1.8655E+02	6.4450E+00
α_2	4.51E-03	1.60E-02	1.44E-02	3.31E-02	0.00E+00	3.0878E+00	1.8991E+02
α_3	1.14E-03	8.45E-03	6.82E-03	2.13E-02	0.00E+00	1.6312E+00	1.9136E+02
α_4	2.57E-04	5.12E-03	3.55E-03	1.54E-02	0.00E+00	9.8887E-01	1.9201E+02
α_5	1.33E-05	2.70E-03	1.28E-03	1.02E-02	0.00E+00	5.2177E-01	1.9247E+02
α_6	3.48E-10	9.65E-04	8.24E-05	5.07E-03	0.00E+00	1.8628E-01	1.9281E+02
α_7	0.00E+00	1.51E-04	1.32E-13	5.67E-04	0.00E+00	2.9071E-02	1.9297E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9460530	0.9673750	0.9687320	0.9840760	1.0000000	2.2123E+02	7.4610E+00
α_2	4.40E-03	1.46E-02	1.32E-02	2.96E-02	0.00E+00	3.3447E+00	2.2535E+02
α_3	1.12E-03	7.60E-03	6.22E-03	1.88E-02	0.00E+00	1.7384E+00	2.2695E+02
α_4	3.55E-04	5.01E-03	3.66E-03	1.43E-02	0.00E+00	1.1465E+00	2.2754E+02
α_5	5.64E-05	3.10E-03	1.82E-03	1.05E-02	0.00E+00	7.0833E-01	2.2798E+02
α_6	9.08E-07	1.60E-03	5.25E-04	6.86E-03	0.00E+00	3.6696E-01	2.2832E+02
α_7	7.12E-14	5.38E-04	9.67E-06	3.06E-03	0.00E+00	1.2297E-01	2.2857E+02
α_8	1.33E-42	1.45E-04	2.06E-12	6.12E-04	0.00E+00	3.3124E-02	2.2866E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	2.50	2.50	2.50	2.50	2.50	2.50	2.50
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.10.4.2 PWR PRESSURIZER CODE SAFETIES FAIL TO CLOSE

System :	Reactor coolant
Component :	Safety Valve (Single Acting)
Failure Mode :	Fail to close (reseat) on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 1.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8522320	0.9628000	0.9843830	0.9999320	1.0000000	1.1246E+01	4.3452E-01
α_2	7.00E-05	3.72E-02	1.56E-02	1.48E-01	0.00E+00	4.3452E-01	1.1246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9010680	0.9652240	0.9744830	0.9976820	1.0000000	3.0555E+01	1.1009E+00
α_2	8.43E-04	2.63E-02	1.72E-02	8.30E-02	0.00E+00	8.3366E-01	3.0822E+01
α_3	2.98E-07	8.44E-03	1.71E-03	4.00E-02	0.00E+00	2.6722E-01	3.1389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9095820	0.9621340	0.9682530	0.9937390	1.0000000	4.7136E+01	1.8551E+00
α_2	2.09E-03	2.51E-02	1.89E-02	6.90E-02	0.00E+00	1.2281E+00	4.7763E+01
α_3	9.32E-06	8.25E-03	3.07E-03	3.41E-02	0.00E+00	4.0431E-01	4.8587E+01
α_4	1.97E-08	4.55E-03	6.24E-04	2.28E-02	0.00E+00	2.2267E-01	4.8768E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	1.00	1.00	1.00
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.11 PORVs

1.11.1 Pooled PORVs

1.11.1.1 POWER OPERATED RELIEF VALVES FAIL TO OPEN ALL SYSTEMS

Component : Power Operated Relief Valve
Failure Mode : Fail to open on demand
Op. Mode : CCF Event Can Only Happen During Power Operation
CCF Event May Occur During Both Power Operation & Shutdown
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 103.30
Total Number of Common-Cause Failure Events: 9

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9301070	0.9729990	0.9785560	0.9968730	0.9763360	5.2986E+01	1.4704E+00
α_2	3.13E-03	2.70E-02	2.14E-02	6.99E-02	2.37E-02	1.4704E+00	5.2986E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9252660	0.9619500	0.9651480	0.9876900	0.9609320	9.1444E+01	3.6171E+00
α_2	9.05E-03	3.21E-02	2.89E-02	6.63E-02	3.45E-02	3.0542E+00	9.2007E+01
α_3	4.22E-05	5.92E-03	2.99E-03	2.17E-02	4.59E-03	5.6292E-01	9.4498E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9294980	0.9605690	0.9628670	0.9837930	0.9601320	1.2750E+02	5.2338E+00
α_2	8.07E-03	2.60E-02	2.37E-02	5.20E-02	2.63E-02	3.4533E+00	1.2928E+02
α_3	1.07E-03	1.04E-02	8.07E-03	2.77E-02	1.15E-02	1.3814E+00	1.3135E+02
α_4	3.08E-06	3.01E-03	1.09E-03	1.25E-02	2.08E-03	3.9907E-01	1.3233E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9413770	0.9647850	0.9662880	0.9830540	0.9650440	1.9751E+02	7.2092E+00
α_2	6.14E-03	1.85E-02	1.70E-02	3.62E-02	1.60E-02	3.7895E+00	2.0093E+02
α_3	2.23E-03	1.09E-02	9.36E-03	2.49E-02	1.20E-02	2.2326E+00	2.0249E+02
α_4	2.67E-04	4.97E-03	3.48E-03	1.48E-02	6.12E-03	1.0169E+00	2.0370E+02
α_5	7.09E-11	8.31E-04	5.38E-05	4.46E-03	9.32E-04	1.7018E-01	2.0455E+02

POWER OPERATED RELIEF VALVES FAIL TO OPEN ALL SYSTEMS

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9458150	0.9665270	0.9677800	0.9829570	0.9682940	2.3820E+02	8.2493E+00
α_2	4.96E-03	1.52E-02	1.39E-02	2.98E-02	1.19E-02	3.7340E+00	2.4272E+02
α_3	1.82E-03	9.01E-03	7.72E-03	2.06E-02	8.61E-03	2.2198E+00	2.4423E+02
α_4	7.46E-04	6.18E-03	4.90E-03	1.60E-02	7.43E-03	1.5223E+00	2.4493E+02
α_5	3.23E-05	2.60E-03	1.44E-03	9.13E-03	3.34E-03	6.4100E-01	2.4581E+02
α_6	3.67E-13	5.37E-04	1.34E-05	3.02E-03	3.91E-04	1.3224E-01	2.4632E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9508030	0.9679990	0.9689260	0.9820370	0.9703990	3.2514E+02	1.0749E+01
α_2	5.23E-03	1.38E-02	1.29E-02	2.56E-02	1.07E-02	4.6366E+00	3.3125E+02
α_3	1.68E-03	7.38E-03	6.43E-03	1.63E-02	5.83E-03	2.4795E+00	3.3341E+02
α_4	9.31E-04	5.62E-03	4.68E-03	1.35E-02	6.19E-03	1.8882E+00	3.3400E+02
α_5	3.15E-04	3.72E-03	2.79E-03	1.03E-02	5.01E-03	1.2498E+00	3.3464E+02
α_6	2.69E-06	1.32E-03	5.39E-04	5.30E-03	1.78E-03	4.4458E-01	3.3544E+02
α_7	1.81E-29	1.49E-04	1.70E-09	7.94E-04	1.44E-04	5.0071E-02	3.3584E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9534110	0.9690220	0.9698140	0.9819230	0.9717640	3.7955E+02	1.2134E+01
α_2	5.17E-03	1.29E-02	1.21E-02	2.35E-02	1.04E-02	5.0723E+00	3.8661E+02
α_3	1.40E-03	6.25E-03	5.43E-03	1.39E-02	4.28E-03	2.4462E+00	3.8924E+02
α_4	7.79E-04	4.77E-03	3.96E-03	1.15E-02	4.37E-03	1.8694E+00	3.8981E+02
α_5	4.60E-04	3.86E-03	3.06E-03	1.00E-02	4.86E-03	1.5123E+00	3.9017E+02
α_6	1.00E-04	2.37E-03	1.59E-03	7.28E-03	3.39E-03	9.2726E-01	3.9076E+02
α_7	2.25E-08	6.79E-04	1.34E-04	3.23E-03	8.65E-04	2.6607E-01	3.9142E+02
α_8	5.57E-36	1.02E-04	4.66E-11	4.93E-04	4.23E-05	4.0124E-02	3.9164E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9763360	0.9609320	0.9601320	0.9650440	0.9682940	0.9703990	0.9717640
α_2	2.37E-02	3.45E-02	2.63E-02	1.60E-02	1.19E-02	1.07E-02	1.04E-02
α_3		4.59E-03	1.15E-02	1.20E-02	8.61E-03	5.83E-03	4.28E-03
α_4			2.08E-03	6.12E-03	7.43E-03	6.19E-03	4.37E-03
α_5				9.32E-04	3.34E-03	5.01E-03	4.86E-03
α_6					3.91E-04	1.78E-03	3.39E-03
α_7						1.44E-04	8.65E-04
α_8							4.23E-05

POWER OPERATED RELIEF VALVES FAIL TO CLOSE ALL SYSTEMS

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.76E-01	9.61E-01	9.60E-01	9.65E-01	9.68E-01	9.70E-01	9.72E-01
Beta	2.37E-02	3.91E-02	3.99E-02	3.50E-02	3.17E-02	2.96E-02	2.82E-02
Gamma		1.18E-01	3.41E-01	5.44E-01	6.24E-01	6.40E-01	6.30E-01
Delta			1.53E-01	3.71E-01	5.65E-01	6.92E-01	7.60E-01
Epsilon				1.32E-01	3.35E-01	5.28E-01	6.77E-01
Mu					1.05E-01	2.77E-01	4.69E-01
Upsilon						7.52E-02	2.11E-01
Sigma							4.66E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	38.76	58.14	77.52	96.90	116.29	135.67	155.05
N_1	3.9796	3.7489	3.8484	4.4453	4.9747	5.4152	5.7670
N_2	1.0359	2.2205	2.2252	1.6753	1.4948	1.5488	1.7276
N_3		0.2957	0.9771	1.2552	1.0780	0.8483	0.7078
N_4			0.1764	0.6425	0.9301	0.8993	0.7229
N_5				0.0979	0.4188	0.7280	0.8040
N_6					0.0490	0.2583	0.5603
N_7						0.0210	0.1431
N_8							0.0070

1.11.1.2 POWER OPERATED RELIEF VALVES FAIL TO CLOSE ALL SYSTEMS

Component : Power Operated Relief Valve
Failure Mode : Fail to close (reseat) on demand
Op. Mode : CCF Event Can Only Happen During Power Operation
CCF Event May Occur During Both Power Operation & Shutdown
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 35.60
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9388350	0.9847360	0.9937760	0.9999690	0.9999050	2.8143E+01	4.3622E-01
α_2	2.83E-05	1.53E-02	6.23E-03	6.12E-02	9.50E-05	4.3622E-01	2.8143E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9449230	0.9807680	0.9859990	0.9987270	0.9998140	5.6395E+01	1.1059E+00
α_2	4.69E-04	1.46E-02	9.46E-03	4.62E-02	1.86E-04	8.3866E-01	5.6662E+01
α_3	1.62E-07	4.65E-03	9.35E-04	2.20E-02	0.00E+00	2.6722E-01	5.7234E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9465470	0.9777390	0.9814220	0.9963350	0.9997210	8.1916E+01	1.8651E+00
α_2	1.24E-03	1.48E-02	1.11E-02	4.08E-02	2.79E-04	1.2381E+00	8.2543E+01
α_3	5.42E-06	4.83E-03	1.79E-03	1.99E-02	0.00E+00	4.0431E-01	8.3377E+01
α_4	1.14E-08	2.66E-03	3.63E-04	1.33E-02	0.00E+00	2.2267E-01	8.3558E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9511940	0.9753920	0.9775570	0.9922000	0.9996420	1.4088E+02	3.5542E+00
α_2	2.86E-03	1.47E-02	1.26E-02	3.41E-02	3.51E-04	2.1299E+00	1.4230E+02
α_3	3.30E-04	6.77E-03	4.67E-03	2.04E-02	6.71E-06	9.7768E-01	1.4346E+02
α_4	1.70E-06	2.59E-03	8.72E-04	1.10E-02	0.00E+00	3.7439E-01	1.4406E+02
α_5	4.13E-21	5.00E-04	2.83E-07	2.90E-03	0.00E+00	7.2277E-02	1.4436E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9536060	0.9754030	0.9771970	0.9910810	0.9995680	1.7059E+02	4.3019E+00
α_2	2.68E-03	1.29E-02	1.11E-02	2.94E-02	4.17E-04	2.2616E+00	1.7263E+02
α_3	4.60E-04	6.53E-03	4.77E-03	1.86E-02	1.49E-05	1.1426E+00	1.7375E+02
α_4	3.02E-05	3.39E-03	1.77E-03	1.22E-02	0.00E+00	5.9222E-01	1.7430E+02
α_5	5.31E-09	1.27E-03	1.72E-04	6.36E-03	0.00E+00	2.2220E-01	1.7467E+02
α_6	8.05E-19	4.76E-04	8.32E-07	2.78E-03	0.00E+00	8.3237E-02	1.7481E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9562670	0.9744110	0.9756540	0.9883200	0.9994940	2.4663E+02	6.4767E+00
α_2	3.49E-03	1.23E-02	1.11E-02	2.54E-02	4.81E-04	3.1179E+00	2.4999E+02
α_3	8.70E-04	6.45E-03	5.21E-03	1.63E-02	2.56E-05	1.6328E+00	2.5147E+02
α_4	1.96E-04	3.91E-03	2.70E-03	1.17E-02	0.00E+00	9.8887E-01	2.5212E+02
α_5	1.01E-05	2.06E-03	9.76E-04	7.79E-03	0.00E+00	5.2177E-01	2.5258E+02
α_6	2.65E-10	7.36E-04	6.28E-05	3.86E-03	0.00E+00	1.8628E-01	2.5292E+02
α_7	0.00E+00	1.15E-04	1.00E-13	4.32E-04	0.00E+00	2.9071E-02	2.5308E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9583010	0.9748030	0.9758620	0.9877030	0.9994260	2.9024E+02	7.5021E+00
α_2	3.44E-03	1.14E-02	1.03E-02	2.30E-02	5.38E-04	3.3832E+00	2.9436E+02
α_3	8.66E-04	5.85E-03	4.78E-03	1.45E-02	3.49E-05	1.7409E+00	2.9600E+02
α_4	2.72E-04	3.85E-03	2.81E-03	1.10E-02	1.40E-06	1.1466E+00	2.9660E+02
α_5	4.33E-05	2.38E-03	1.40E-03	8.05E-03	0.00E+00	7.0833E-01	2.9703E+02
α_6	6.97E-07	1.23E-03	4.03E-04	5.27E-03	0.00E+00	3.6696E-01	2.9738E+02
α_7	5.47E-14	4.13E-04	7.42E-06	2.35E-03	0.00E+00	1.2297E-01	2.9762E+02
α_8	1.02E-42	1.11E-04	1.58E-12	4.70E-04	0.00E+00	3.3124E-02	2.9771E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9999050	0.9998140	0.9997210	0.9996420	0.9995680	0.9994940	0.9994260
α_2	9.50E-05	1.86E-04	2.79E-04	3.51E-04	4.17E-04	4.81E-04	5.38E-04
α_3		0.00E+00	0.00E+00	6.71E-06	1.49E-05	2.56E-05	3.49E-05
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.40E-06
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01
Beta	9.50E-05	1.86E-04	2.79E-04	3.58E-04	4.32E-04	5.06E-04	5.74E-04
Gamma		0.00E+00	0.00E+00	1.88E-02	3.45E-02	5.05E-02	6.33E-02
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.85E-02
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	17.80	26.70	35.60	44.50	53.40	62.30	71.20
N_1	0.0967	0.1400	0.1800	0.2175	0.2523	0.2845	0.3143
N_2	0.0017	0.0050	0.0100	0.0157	0.0224	0.0301	0.0385
N_3		0.0000	0.0000	0.0003	0.0008	0.0016	0.0025
N_4			0.0000	0.0000	0.0000	0.0000	0.0001
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.11.2 PWR Steam Generator PORV

1.11.2.1 PWR MAIN STEAM PORV FAIL TO OPEN SPAR: ADV-CC

System : Main steam
Component : Power Operated Relief Valve
Failure Mode : Fail to open on demand
Plant Type : PWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 82.20
Total Number of Common-Cause Failure Events: 7

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9093860	0.9650140	0.9722010	0.9960100	0.9669900	4.0006E+01	1.4504E+00
α_2	3.99E-03	3.50E-02	2.78E-02	9.06E-02	3.30E-02	1.4504E+00	4.0006E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9073950	0.9528880	0.9568360	0.9848680	0.9452470	7.2028E+01	3.5611E+00
α_2	1.11E-02	3.97E-02	3.57E-02	8.20E-02	4.82E-02	3.0002E+00	7.2589E+01
α_3	5.21E-05	7.42E-03	3.75E-03	2.73E-02	6.54E-03	5.6092E-01	7.5028E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9139530	0.9519740	0.9547720	0.9804200	0.9443270	1.0167E+02	5.1292E+00
α_2	9.56E-03	3.14E-02	2.85E-02	6.31E-02	3.62E-02	3.3561E+00	1.0344E+02
α_3	1.31E-03	1.29E-02	9.98E-03	3.43E-02	1.65E-02	1.3742E+00	1.0542E+02
α_4	3.82E-06	3.73E-03	1.36E-03	1.55E-02	3.00E-03	3.9887E-01	1.0640E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9317080	0.9591130	0.9608770	0.9804820	0.9517050	1.6529E+02	7.0463E+00
α_2	6.82E-03	2.11E-02	1.93E-02	4.17E-02	2.11E-02	3.6437E+00	1.6869E+02
α_3	2.61E-03	1.29E-02	1.10E-02	2.94E-02	1.71E-02	2.2164E+00	1.7012E+02
α_4	3.16E-04	5.90E-03	4.13E-03	1.75E-02	8.83E-03	1.0160E+00	1.7132E+02
α_5	8.43E-11	9.87E-04	6.39E-05	5.30E-03	1.35E-03	1.7018E-01	1.7217E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9371870	0.9613720	0.9628480	0.9805190	0.9566970	1.9962E+02	8.0208E+00
α_2	5.36E-03	1.70E-02	1.55E-02	3.39E-02	1.50E-02	3.5372E+00	2.0410E+02
α_3	2.11E-03	1.05E-02	9.02E-03	2.42E-02	1.21E-02	2.1906E+00	2.0545E+02
α_4	8.82E-04	7.32E-03	5.81E-03	1.89E-02	1.07E-02	1.5199E+00	2.0612E+02
α_5	3.84E-05	3.09E-03	1.70E-03	1.08E-02	4.85E-03	6.4090E-01	2.0700E+02
α_6	4.36E-13	6.37E-04	1.59E-05	3.59E-03	5.67E-04	1.3224E-01	2.0751E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9444810	0.9640480	0.9651110	0.9799940	0.9600180	2.8020E+02	1.0449E+01
α_2	5.53E-03	1.51E-02	1.40E-02	2.84E-02	1.30E-02	4.3886E+00	2.8626E+02
α_3	1.87E-03	8.37E-03	7.27E-03	1.86E-02	8.01E-03	2.4336E+00	2.8822E+02
α_4	1.07E-03	6.48E-03	5.39E-03	1.56E-02	8.93E-03	1.8831E+00	2.8877E+02
α_5	3.63E-04	4.30E-03	3.23E-03	1.19E-02	7.27E-03	1.2495E+00	2.8940E+02
α_6	3.11E-06	1.53E-03	6.24E-04	6.12E-03	2.58E-03	4.4458E-01	2.9020E+02
α_7	2.09E-29	1.72E-04	1.96E-09	9.18E-04	2.10E-04	5.0071E-02	2.9060E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9477350	0.9654160	0.9663230	0.9799970	0.9622400	3.2828E+02	1.1760E+01
α_2	5.41E-03	1.40E-02	1.31E-02	2.59E-02	1.26E-02	4.7747E+00	3.3527E+02
α_3	1.53E-03	7.00E-03	6.06E-03	1.57E-02	5.64E-03	2.3801E+00	3.3766E+02
α_4	8.88E-04	5.47E-03	4.54E-03	1.32E-02	6.27E-03	1.8603E+00	3.3818E+02
α_5	5.30E-04	4.45E-03	3.52E-03	1.15E-02	7.05E-03	1.5115E+00	3.3853E+02
α_6	1.15E-04	2.73E-03	1.84E-03	8.38E-03	4.92E-03	9.2716E-01	3.3911E+02
α_7	2.59E-08	7.82E-04	1.55E-04	3.72E-03	1.26E-03	2.6607E-01	3.3977E+02
α_8	6.42E-36	1.18E-04	5.37E-11	5.68E-04	6.15E-05	4.0124E-02	3.4000E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9669900	0.9452470	0.9443270	0.9517050	0.9566970	0.9600180	0.9622400
α_2	3.30E-02	4.82E-02	3.62E-02	2.11E-02	1.50E-02	1.30E-02	1.26E-02
α_3		6.54E-03	1.65E-02	1.71E-02	1.21E-02	8.01E-03	5.64E-03
α_4			3.00E-03	8.83E-03	1.07E-02	8.93E-03	6.27E-03
α_5				1.35E-03	4.85E-03	7.27E-03	7.05E-03
α_6					5.67E-04	2.58E-03	4.92E-03
α_7						2.10E-04	1.26E-03
α_8							6.15E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.67E-01	9.45E-01	9.44E-01	9.52E-01	9.57E-01	9.60E-01	9.62E-01
Beta	3.30E-02	5.48E-02	5.57E-02	4.83E-02	4.33E-02	4.00E-02	3.78E-02
Gamma		1.19E-01	3.50E-01	5.64E-01	6.53E-01	6.75E-01	6.67E-01
Delta			1.54E-01	3.74E-01	5.71E-01	7.03E-01	7.76E-01
Epsilon				1.32E-01	3.35E-01	5.30E-01	6.80E-01
Mu					1.05E-01	2.77E-01	4.69E-01
Upsilon						7.52E-02	2.11E-01
Sigma							4.66E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	26.14	39.21	52.27	65.34	78.41	91.48	104.55
N_1	3.6196	3.2629	3.2652	3.7892	4.2661	4.6712	5.0018
N_2	1.0159	2.1665	2.1280	1.5295	1.2980	1.3008	1.4300
N_3		0.2937	0.9699	1.2390	1.0488	0.8024	0.6417
N_4			0.1762	0.6416	0.9277	0.8942	0.7138
N_5				0.0979	0.4187	0.7277	0.8032
N_6					0.0490	0.2583	0.5602
N_7						0.0210	0.1431
N_8							0.0070

1.11.2.2 PWR MAIN STEAM PORV FAIL TO CLOSE SPAR: ADV-OO

System :	Main steam
Component :	Power Operated Relief Valve
Failure Mode :	Fail to close (reseat) on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 29.50
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9315820	0.9829130	0.9930140	0.9999650	0.9998860	2.5093E+01	4.3622E-01
α_2	3.18E-05	1.71E-02	6.99E-03	6.84E-02	1.14E-04	4.3622E-01	2.5093E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9402240	0.9791070	0.9847750	0.9986110	0.9997760	5.1825E+01	1.1059E+00
α_2	5.10E-04	1.58E-02	1.03E-02	5.01E-02	2.24E-04	8.3866E-01	5.2092E+01
α_3	1.77E-07	5.05E-03	1.02E-03	2.39E-02	0.00E+00	2.6722E-01	5.2664E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9423960	0.9759910	0.9799510	0.9960420	0.9996630	7.5816E+01	1.8651E+00
α_2	1.34E-03	1.59E-02	1.20E-02	4.40E-02	3.37E-04	1.2381E+00	7.6443E+01
α_3	5.85E-06	5.20E-03	1.93E-03	2.15E-02	0.00E+00	4.0431E-01	7.7277E+01
α_4	1.23E-08	2.87E-03	3.92E-04	1.44E-02	0.00E+00	2.2267E-01	7.7458E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9485020	0.9740210	0.9763010	0.9917600	0.9995690	1.3326E+02	3.5542E+00
α_2	3.02E-03	1.56E-02	1.33E-02	3.60E-02	4.23E-04	2.1299E+00	1.3468E+02
α_3	3.49E-04	7.15E-03	4.93E-03	2.15E-02	8.08E-06	9.7768E-01	1.3584E+02
α_4	1.80E-06	2.74E-03	9.21E-04	1.16E-02	0.00E+00	3.7439E-01	1.3644E+02
α_5	4.36E-21	5.28E-04	2.98E-07	3.06E-03	0.00E+00	7.2277E-02	1.3674E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9510670	0.9740450	0.9759320	0.9905770	0.9994790	1.6144E+02	4.3019E+00
α_2	2.83E-03	1.36E-02	1.17E-02	3.10E-02	5.03E-04	2.2616E+00	1.6348E+02
α_3	4.85E-04	6.89E-03	5.04E-03	1.96E-02	1.80E-05	1.1426E+00	1.6460E+02
α_4	3.19E-05	3.57E-03	1.87E-03	1.29E-02	0.00E+00	5.9222E-01	1.6515E+02
α_5	5.60E-09	1.34E-03	1.82E-04	6.72E-03	0.00E+00	2.2220E-01	1.6552E+02
α_6	8.50E-19	5.02E-04	8.78E-07	2.93E-03	0.00E+00	8.3237E-02	1.6566E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9543560	0.9732850	0.9745790	0.9878010	0.9993900	2.3596E+02	6.4767E+00
α_2	3.65E-03	1.29E-02	1.15E-02	2.66E-02	5.79E-04	3.1179E+00	2.3932E+02
α_3	9.08E-04	6.73E-03	5.44E-03	1.70E-02	3.08E-05	1.6328E+00	2.4080E+02
α_4	2.04E-04	4.08E-03	2.82E-03	1.22E-02	0.00E+00	9.8887E-01	2.4145E+02
α_5	1.06E-05	2.15E-03	1.02E-03	8.14E-03	0.00E+00	5.2177E-01	2.4191E+02
α_6	2.77E-10	7.68E-04	6.56E-05	4.03E-03	0.00E+00	1.8628E-01	2.4225E+02
α_7	0.00E+00	1.20E-04	1.05E-13	4.51E-04	0.00E+00	2.9071E-02	2.4241E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9565320	0.9737270	0.9748280	0.9871730	0.9993080	2.7804E+02	7.5021E+00
α_2	3.59E-03	1.18E-02	1.07E-02	2.39E-02	6.49E-04	3.3832E+00	2.8216E+02
α_3	9.03E-04	6.10E-03	4.99E-03	1.51E-02	4.21E-05	1.7409E+00	2.8380E+02
α_4	2.84E-04	4.02E-03	2.93E-03	1.14E-02	1.68E-06	1.1466E+00	2.8440E+02
α_5	4.51E-05	2.48E-03	1.46E-03	8.40E-03	0.00E+00	7.0833E-01	2.8483E+02
α_6	7.27E-07	1.29E-03	4.21E-04	5.50E-03	0.00E+00	3.6696E-01	2.8518E+02
α_7	5.70E-14	4.31E-04	7.74E-06	2.45E-03	0.00E+00	1.2297E-01	2.8542E+02
α_8	1.07E-42	1.16E-04	1.65E-12	4.90E-04	0.00E+00	3.3124E-02	2.8551E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9998860	0.9997760	0.9996630	0.9995690	0.9994790	0.9993900	0.9993080
α_2	1.14E-04	2.24E-04	3.37E-04	4.23E-04	5.03E-04	5.79E-04	6.49E-04
α_3		0.00E+00	0.00E+00	8.08E-06	1.80E-05	3.08E-05	4.21E-05
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E-06
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.99E-01
Beta	1.14E-04	2.24E-04	3.37E-04	4.31E-04	5.21E-04	6.10E-04	6.92E-04
Gamma		0.00E+00	0.00E+00	1.88E-02	3.45E-02	5.05E-02	6.33E-02
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.85E-02
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	14.75	22.13	29.50	36.88	44.25	51.63	59.00
N_1	0.0967	0.1400	0.1800	0.2175	0.2523	0.2845	0.3143
N_2	0.0017	0.0050	0.0100	0.0157	0.0224	0.0301	0.0385
N_3		0.0000	0.0000	0.0003	0.0008	0.0016	0.0025
N_4			0.0000	0.0000	0.0000	0.0000	0.0001
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.11.3 PWR Pressurizer Power Operated Relief Valves

1.11.3.1 PRESSURIZER PORVS FAIL TO OPEN SPAR: PPR-SRV-CC

System :	Reactor coolant
Component :	Power Operated Relief Valve
Failure Mode :	Fail to open on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 19.10
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9404860	0.9849300	0.9936000	0.9999610	0.9989730	2.9706E+01	4.5452E-01
α_2	3.57E-05	1.51E-02	6.40E-03	5.95E-02	1.03E-03	4.5452E-01	2.9706E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9455050	0.9806700	0.9857140	0.9985830	0.9980820	5.8691E+01	1.1569E+00
α_2	5.63E-04	1.48E-02	9.88E-03	4.60E-02	1.85E-03	8.8766E-01	5.8960E+01
α_3	1.70E-07	4.50E-03	9.17E-04	2.13E-02	6.85E-05	2.6922E-01	5.9579E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9466870	0.9774440	0.9810010	0.9960380	0.9973100	8.4919E+01	1.9597E+00
α_2	1.46E-03	1.53E-02	1.17E-02	4.11E-02	2.50E-03	1.3253E+00	8.5553E+01
α_3	5.97E-06	4.74E-03	1.79E-03	1.95E-02	1.85E-04	4.1151E-01	8.6467E+01
α_4	1.12E-08	2.57E-03	3.51E-04	1.28E-02	5.14E-06	2.2287E-01	8.6656E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9989730	0.9980820	0.9973100
α_2	1.03E-03	1.85E-03	2.50E-03
α_3		6.85E-05	1.85E-04
α_4			5.14E-06

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.99E-01	9.98E-01	9.97E-01
Beta	1.03E-03	1.92E-03	2.69E-03
Gamma		3.57E-02	7.07E-02
Delta			2.70E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	19.10	28.65	38.20
N_1	0.3600	0.4860	0.5832
N_2	0.0200	0.0540	0.0972
N_3		0.0020	0.0072
N_4			0.0002

1.11.3.2 PWR PRESSURIZER PORVS FAIL TO CLOSE

System :	Reactor coolant
Component :	Power Operated Relief Valve
Failure Mode :	Fail to close (reseat) on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 5.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8901120	0.9724650	0.9886040	0.9999450	1.0000000	1.5346E+01	4.3452E-01
α_2	5.09E-05	2.75E-02	1.14E-02	1.10E-01	0.00E+00	4.3452E-01	1.5346E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9122210	0.9692110	0.9774640	0.9979560	1.0000000	3.4655E+01	1.1009E+00
α_2	7.44E-04	2.33E-02	1.52E-02	7.36E-02	0.00E+00	8.3366E-01	3.4922E+01
α_3	2.63E-07	7.47E-03	1.51E-03	3.54E-02	0.00E+00	2.6722E-01	3.5489E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9164510	0.9650590	0.9707310	0.9942350	1.0000000	5.1236E+01	1.8551E+00
α_2	1.92E-03	2.31E-02	1.75E-02	6.38E-02	0.00E+00	1.2281E+00	5.1863E+01
α_3	8.59E-06	7.62E-03	2.83E-03	3.14E-02	0.00E+00	4.0431E-01	5.2687E+01
α_4	1.81E-08	4.19E-03	5.75E-04	2.10E-02	0.00E+00	2.2267E-01	5.2868E+01

ALPHA FACTOR and MGL PARAMETERS

PWR PRESSURIZER PORVS FAIL TO CLOSE

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	5.10	5.10	5.10
N_1	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.12 Main Steam Isolation Valves

1.12.1 PWR Main Steam Isolation Valves

1.12.1.1 PWR MSIV FAIL TO OPEN

System :	Main steam
Component :	Main Steam Stop Valve
Failure Mode :	Fail to open on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 18.30
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8916130	0.9652050	0.9769050	0.9988010	0.9697680	2.3613E+01	8.5122E-01
α_2	1.20E-03	3.48E-02	2.31E-02	1.08E-01	3.02E-02	8.5122E-01	2.3613E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9052190	0.9586680	0.9645460	0.9919860	0.9504340	4.8730E+01	2.1009E+00
α_2	4.95E-03	3.36E-02	2.77E-02	8.26E-02	4.34E-02	1.7087E+00	4.9122E+01
α_3	7.10E-06	7.72E-03	2.77E-03	3.22E-02	6.20E-03	3.9222E-01	5.0439E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9062040	0.9523390	0.9563490	0.9847480	0.9359280	7.0786E+01	3.5426E+00
α_2	8.53E-03	3.50E-02	3.09E-02	7.55E-02	5.22E-02	2.6031E+00	7.1725E+01
α_3	1.20E-04	8.80E-03	4.96E-03	3.06E-02	9.49E-03	6.5431E-01	7.3674E+01
α_4	2.57E-07	3.84E-03	8.66E-04	1.78E-02	2.37E-03	2.8517E-01	7.4043E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9280180	0.9595160	0.9618140	0.9831520	0.9441740	1.2682E+02	5.3509E+00
α_2	6.63E-03	2.34E-02	2.10E-02	4.83E-02	3.02E-02	3.0934E+00	1.2908E+02
α_3	1.65E-03	1.23E-02	9.92E-03	3.10E-02	1.99E-02	1.6232E+00	1.3055E+02
α_4	2.15E-05	4.02E-03	1.93E-03	1.51E-02	4.81E-03	5.3069E-01	1.3164E+02
α_5	1.27E-15	7.84E-04	5.75E-06	4.55E-03	9.64E-04	1.0358E-01	1.3207E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9335470	0.9613940	0.9633040	0.9827080	0.9510010	1.5363E+02	6.1693E+00
α_2	4.90E-03	1.83E-02	1.63E-02	3.84E-02	1.76E-02	2.9180E+00	1.5688E+02
α_3	1.99E-03	1.19E-02	9.91E-03	2.85E-02	1.96E-02	1.8987E+00	1.5790E+02
α_4	2.56E-04	5.87E-03	3.98E-03	1.79E-02	8.95E-03	9.3772E-01	1.5886E+02
α_5	3.38E-07	1.98E-03	5.25E-04	8.89E-03	2.43E-03	3.1600E-01	1.5948E+02
α_6	2.62E-16	6.19E-04	3.43E-06	3.60E-03	4.04E-04	9.8837E-02	1.5970E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9425240	0.9643570	0.9656690	0.9817220	0.9566460	2.2680E+02	8.3826E+00
α_2	4.76E-03	1.51E-02	1.37E-02	3.00E-02	1.03E-02	3.5482E+00	2.3163E+02
α_3	2.16E-03	9.99E-03	8.64E-03	2.24E-02	1.61E-02	2.3491E+00	2.3283E+02
α_4	7.31E-04	6.31E-03	4.98E-03	1.65E-02	1.11E-02	1.4846E+00	2.3370E+02
α_5	6.02E-05	3.07E-03	1.83E-03	1.03E-02	4.50E-03	7.2287E-01	2.3446E+02
α_6	1.14E-08	1.02E-03	1.66E-04	5.01E-03	1.22E-03	2.4098E-01	2.3494E+02
α_7	1.28E-38	1.57E-04	1.69E-11	7.17E-04	1.75E-04	3.6871E-02	2.3515E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9463770	0.9659700	0.9670890	0.9817520	0.9613200	2.6756E+02	9.4258E+00
α_2	4.24E-03	1.32E-02	1.20E-02	2.61E-02	6.04E-03	3.6516E+00	2.7333E+02
α_3	1.83E-03	8.49E-03	7.34E-03	1.91E-02	1.21E-02	2.3522E+00	2.7463E+02
α_4	8.99E-04	6.20E-03	5.05E-03	1.54E-02	1.12E-02	1.7162E+00	2.7527E+02
α_5	2.03E-04	3.70E-03	2.60E-03	1.10E-02	6.25E-03	1.0258E+00	2.7596E+02
α_6	6.15E-06	1.76E-03	7.88E-04	6.83E-03	2.40E-03	4.8866E-01	2.7650E+02
α_7	8.43E-12	5.57E-04	2.57E-05	3.05E-03	6.16E-04	1.5427E-01	2.7683E+02
α_8	1.52E-38	1.34E-04	1.55E-11	6.12E-04	7.68E-05	3.7024E-02	2.7695E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9697680	0.9504340	0.9359280	0.9441740	0.9510010	0.9566460	0.9613200
α_2	3.02E-02	4.34E-02	5.22E-02	3.02E-02	1.76E-02	1.03E-02	6.04E-03
α_3		6.20E-03	9.49E-03	1.99E-02	1.96E-02	1.61E-02	1.21E-02
α_4			2.37E-03	4.81E-03	8.95E-03	1.11E-02	1.12E-02
α_5				9.64E-04	2.43E-03	4.50E-03	6.25E-03
α_6					4.04E-04	1.22E-03	2.40E-03
α_7						1.75E-04	6.16E-04
α_8							7.68E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.70E-01	9.50E-01	9.36E-01	9.44E-01	9.51E-01	9.57E-01	9.61E-01
Beta	3.02E-02	4.96E-02	6.41E-02	5.58E-02	4.90E-02	4.34E-02	3.87E-02
Gamma		1.25E-01	1.85E-01	4.60E-01	6.41E-01	7.62E-01	8.44E-01
Delta			2.00E-01	2.25E-01	3.75E-01	5.14E-01	6.30E-01
Epsilon				1.67E-01	2.40E-01	3.47E-01	4.54E-01
Mu					1.43E-01	2.37E-01	3.31E-01
Upsilon						1.25E-01	2.24E-01
Sigma							1.11E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	12.20	18.30	24.40	30.50	36.60	42.70	48.80
N_1	1.1667	0.8750	0.2500	0.1563	0.0938	0.0547	0.0313
N_2	0.4167	0.8750	1.3750	0.9792	0.6788	0.4604	0.3069
N_3		0.1250	0.2500	0.6458	0.7569	0.7179	0.6138
N_4			0.0625	0.1563	0.3455	0.4957	0.5697
N_5				0.0313	0.0938	0.2011	0.3175
N_6					0.0156	0.0547	0.1217
N_7						0.0078	0.0313
N_8							0.0039

1.12.1.2 PWR MSIV FAIL TO CLOSE

System :	Main steam
Component :	Main Steam Stop Valve
Failure Mode :	Fail to close (reseat) on demand
Plant Type :	PWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 30.40
Total Number of Common-Cause Failure Events: 6

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8721560	0.9508060	0.9609690	0.9946290	0.9457190	2.7146E+01	1.4045E+00
α_2	5.37E-03	4.92E-02	3.90E-02	1.28E-01	5.43E-02	1.4045E+00	2.7146E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8737080	0.9348370	0.9399580	0.9784500	0.8997060	5.2520E+01	3.6609E+00
α_2	1.71E-02	5.73E-02	5.21E-02	1.15E-01	9.34E-02	3.2187E+00	5.2962E+01
α_3	1.57E-05	7.87E-03	3.22E-03	3.15E-02	6.86E-03	4.4222E-01	5.5739E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8814570	0.9324250	0.9359770	0.9712540	0.8901500	7.5361E+01	5.4616E+00
α_2	1.60E-02	4.73E-02	4.36E-02	9.12E-02	7.90E-02	3.8216E+00	7.7001E+01
α_3	1.67E-03	1.68E-02	1.30E-02	4.48E-02	2.90E-02	1.3548E+00	7.9468E+01
α_4	2.36E-07	3.53E-03	7.96E-04	1.64E-02	1.90E-03	2.8517E-01	8.0537E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9114240	0.9459850	0.9481070	0.9733090	0.8998520	1.3219E+02	7.5479E+00
α_2	1.01E-02	2.89E-02	2.67E-02	5.53E-02	4.81E-02	4.0390E+00	1.3570E+02
α_3	4.57E-03	1.88E-02	1.65E-02	4.07E-02	4.11E-02	2.6246E+00	1.3711E+02
α_4	1.42E-04	5.59E-03	3.47E-03	1.82E-02	1.01E-02	7.8069E-01	1.3896E+02
α_5	1.20E-15	7.41E-04	5.43E-06	4.30E-03	7.82E-04	1.0358E-01	1.3963E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9194340	0.9497500	0.9515210	0.9740090	0.9113560	1.5996E+02	8.4632E+00
α_2	5.96E-03	1.98E-02	1.79E-02	4.00E-02	2.32E-02	3.3341E+00	1.6509E+02
α_3	5.77E-03	1.95E-02	1.76E-02	3.95E-02	4.52E-02	3.2765E+00	1.6515E+02
α_4	7.27E-04	7.79E-03	5.95E-03	2.12E-02	1.53E-02	1.3128E+00	1.6711E+02
α_5	5.08E-06	2.62E-03	1.06E-03	1.05E-02	4.63E-03	4.4100E-01	1.6798E+02
α_6	2.48E-16	5.87E-04	3.25E-06	3.41E-03	3.30E-04	9.8837E-02	1.6832E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9327360	0.9561310	0.9573660	0.9753040	0.9209670	2.3412E+02	1.0742E+01
α_2	5.48E-03	1.61E-02	1.48E-02	3.11E-02	1.57E-02	3.9401E+00	2.4092E+02
α_3	3.85E-03	1.32E-02	1.19E-02	2.70E-02	2.94E-02	3.2288E+00	2.4163E+02
α_4	1.91E-03	9.23E-03	7.93E-03	2.10E-02	2.34E-02	2.2598E+00	2.4260E+02
α_5	1.91E-04	3.97E-03	2.73E-03	1.20E-02	8.30E-03	9.7287E-01	2.4389E+02
α_6	1.48E-07	1.24E-03	3.09E-04	5.65E-03	2.16E-03	3.0348E-01	2.4456E+02
α_7	1.23E-38	1.51E-04	1.62E-11	6.88E-04	1.43E-04	3.6871E-02	2.4483E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9379050	0.9587940	0.9598520	0.9760660	0.9285640	2.7584E+02	1.1855E+01
α_2	4.88E-03	1.41E-02	1.30E-02	2.71E-02	1.15E-02	4.0517E+00	2.8364E+02
α_3	2.73E-03	1.02E-02	9.06E-03	2.14E-02	1.93E-02	2.9256E+00	2.8477E+02
α_4	2.02E-03	8.73E-03	7.62E-03	1.92E-02	2.22E-02	2.5117E+00	2.8518E+02
α_5	6.12E-04	5.21E-03	4.12E-03	1.35E-02	1.28E-02	1.4983E+00	2.8620E+02
α_6	2.86E-05	2.24E-03	1.24E-03	7.85E-03	4.52E-03	6.4496E-01	2.8705E+02
α_7	2.17E-10	6.45E-04	5.43E-05	3.39E-03	1.02E-03	1.8547E-01	2.8751E+02
α_8	1.46E-38	1.29E-04	1.49E-11	5.90E-04	6.34E-05	3.7024E-02	2.8766E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9457190	0.8997060	0.8901500	0.8998520	0.9113560	0.9209670	0.9285640
α_2	5.43E-02	9.34E-02	7.90E-02	4.81E-02	2.32E-02	1.57E-02	1.15E-02
α_3		6.86E-03	2.90E-02	4.11E-02	4.52E-02	2.94E-02	1.93E-02
α_4			1.90E-03	1.01E-02	1.53E-02	2.34E-02	2.22E-02
α_5				7.82E-04	4.63E-03	8.30E-03	1.28E-02
α_6					3.30E-04	2.16E-03	4.52E-03
α_7						1.43E-04	1.02E-03
α_8							6.34E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.46E-01	9.00E-01	8.90E-01	9.00E-01	9.11E-01	9.21E-01	9.29E-01
Beta	5.43E-02	1.00E-01	1.10E-01	1.00E-01	8.86E-02	7.90E-02	7.14E-02
Gamma		6.84E-02	2.81E-01	5.20E-01	7.38E-01	8.02E-01	8.39E-01
Delta			6.17E-02	2.10E-01	3.09E-01	5.36E-01	6.78E-01
Epsilon				7.15E-02	2.45E-01	3.12E-01	4.54E-01
Mu					6.66E-02	2.17E-01	3.04E-01
Upsilon						6.24E-02	1.93E-01
Sigma							5.87E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	14.04	21.06	28.08	35.10	42.12	49.15	56.17
N_1	2.8600	1.9050	1.1447	0.9270	0.9024	0.9218	0.9427
N_2	0.9700	2.3850	2.5935	1.9248	1.0949	0.8523	0.7070
N_3		0.1750	0.9505	1.6472	2.1347	1.5976	1.1872
N_4			0.0625	0.4063	0.7206	1.2709	1.3652
N_5				0.0313	0.2188	0.4511	0.7900
N_6					0.0156	0.1172	0.2780
N_7						0.0078	0.0625
N_8							0.0039

1.12.2 BWR Main Steam Isolation Valves

1.12.2.1 BWR MSIV FAIL TO OPEN

Component : Main Steam Stop Valve
Failure Mode : Fail to open on demand
Plant Type : BWR
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 4.10
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8532180	0.9630530	0.9844950	0.9999320	1.0000000	1.1326E+01	4.3452E-01
α_2	6.95E-05	3.69E-02	1.55E-02	1.47E-01	0.00E+00	4.3452E-01	1.1326E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9029140	0.9658830	0.9749770	0.9977270	0.9999380	3.1170E+01	1.1010E+00
α_2	8.27E-04	2.58E-02	1.69E-02	8.15E-02	6.19E-05	8.3376E-01	3.1437E+01
α_3	2.92E-07	8.28E-03	1.68E-03	3.93E-02	0.00E+00	2.6722E-01	3.2004E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9116140	0.9629990	0.9689880	0.9938850	0.9999070	4.8286E+01	1.8553E+00
α_2	2.04E-03	2.45E-02	1.85E-02	6.75E-02	9.30E-05	1.2283E+00	4.8913E+01
α_3	9.11E-06	8.06E-03	3.00E-03	3.33E-02	0.00E+00	4.0431E-01	4.9737E+01
α_4	1.92E-08	4.44E-03	6.10E-04	2.22E-02	0.00E+00	2.2267E-01	4.9919E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9316220	0.9654370	0.9684310	0.9890210	0.9998510	9.8845E+01	3.5386E+00
α_2	3.98E-03	2.07E-02	1.76E-02	4.77E-02	1.49E-04	2.1146E+00	1.0027E+02
α_3	4.67E-04	9.55E-03	6.60E-03	2.87E-02	0.00E+00	9.7738E-01	1.0141E+02
α_4	2.41E-06	3.66E-03	1.23E-03	1.55E-02	0.00E+00	3.7439E-01	1.0201E+02
α_5	5.83E-21	7.06E-04	3.99E-07	4.09E-03	0.00E+00	7.2277E-02	1.0231E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9352770	0.9656150	0.9680850	0.9875130	0.9998450	1.2017E+02	4.2792E+00
α_2	3.70E-03	1.80E-02	1.55E-02	4.09E-02	1.55E-04	2.2397E+00	1.2221E+02
α_3	6.46E-04	9.17E-03	6.71E-03	2.61E-02	0.00E+00	1.1418E+00	1.2331E+02
α_4	4.26E-05	4.76E-03	2.49E-03	1.72E-02	0.00E+00	5.9222E-01	1.2386E+02
α_5	7.47E-09	1.79E-03	2.42E-04	8.95E-03	0.00E+00	2.2220E-01	1.2423E+02
α_6	1.13E-18	6.69E-04	1.17E-06	3.90E-03	0.00E+00	8.3237E-02	1.2437E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9433540	0.9668180	0.9684120	0.9848430	0.9997870	1.8781E+02	6.4458E+00
α_2	4.48E-03	1.59E-02	1.43E-02	3.29E-02	2.13E-04	3.0886E+00	1.9117E+02
α_3	1.13E-03	8.40E-03	6.78E-03	2.12E-02	0.00E+00	1.6312E+00	1.9262E+02
α_4	2.55E-04	5.09E-03	3.52E-03	1.53E-02	0.00E+00	9.8887E-01	1.9327E+02
α_5	1.32E-05	2.69E-03	1.27E-03	1.02E-02	0.00E+00	5.2177E-01	1.9373E+02
α_6	3.46E-10	9.59E-04	8.19E-05	5.03E-03	0.00E+00	1.8628E-01	1.9407E+02
α_7	0.00E+00	1.50E-04	1.31E-13	5.63E-04	0.00E+00	2.9071E-02	1.9423E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9464650	0.9676260	0.9689730	0.9841990	0.9997670	2.2303E+02	7.4620E+00
α_2	4.37E-03	1.45E-02	1.31E-02	2.94E-02	2.33E-04	3.3457E+00	2.2715E+02
α_3	1.12E-03	7.54E-03	6.17E-03	1.86E-02	0.00E+00	1.7384E+00	2.2875E+02
α_4	3.52E-04	4.97E-03	3.64E-03	1.42E-02	0.00E+00	1.1465E+00	2.2935E+02
α_5	5.59E-05	3.07E-03	1.81E-03	1.04E-02	0.00E+00	7.0833E-01	2.2978E+02
α_6	9.01E-07	1.59E-03	5.21E-04	6.81E-03	0.00E+00	3.6696E-01	2.3013E+02
α_7	7.07E-14	5.34E-04	9.60E-06	3.04E-03	0.00E+00	1.2297E-01	2.3037E+02
α_8	1.32E-42	1.44E-04	2.05E-12	6.07E-04	0.00E+00	3.3124E-02	2.3046E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	0.9999380	0.9999070	0.9998510	0.9998450	0.9997870	0.9997670
α_2	0.00E+00	6.19E-05	9.30E-05	1.49E-04	1.55E-04	2.13E-04	2.33E-04
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	6.19E-05	9.30E-05	1.49E-04	1.55E-04	2.13E-04	2.33E-04
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	1.03	1.54	2.05	2.56	3.08	3.59	4.10
N_1	0.0499	0.0748	0.0996	0.1243	0.1489	0.1735	0.1980
N_2	0.0000	0.0001	0.0002	0.0004	0.0005	0.0008	0.0010
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.12.2.2 BWR MSIV FAIL TO CLOSE

Component :	Main Steam Stop Valve
Failure Mode :	Fail to close (reseat) on demand
Plant Type :	BWR
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 8.90
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8649760	0.9648120	0.9838540	0.9998860	0.9848060	1.3137E+01	4.7912E-01
α_2	1.16E-04	3.52E-02	1.61E-02	1.35E-01	1.52E-02	4.7912E-01	1.3137E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9035160	0.9647070	0.9731410	0.9970070	0.9690830	3.3752E+01	1.2348E+00
α_2	1.34E-03	2.77E-02	1.93E-02	8.26E-02	3.09E-02	9.6756E-01	3.4019E+01
α_3	2.69E-07	7.64E-03	1.55E-03	3.62E-02	0.00E+00	2.6722E-01	3.4720E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9095090	0.9604460	0.9660320	0.9922400	0.9528530	5.1550E+01	2.1230E+00
α_2	3.33E-03	2.79E-02	2.22E-02	7.17E-02	4.71E-02	1.4960E+00	5.2177E+01
α_3	8.50E-06	7.53E-03	2.80E-03	3.11E-02	0.00E+00	4.0431E-01	5.3269E+01
α_4	1.79E-08	4.15E-03	5.69E-04	2.08E-02	0.00E+00	2.2267E-01	5.3450E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9284680	0.9626500	0.9655120	0.9870530	0.9361240	1.0270E+02	3.9846E+00
α_2	5.71E-03	2.40E-02	2.11E-02	5.22E-02	6.39E-02	2.5606E+00	1.0412E+02
α_3	4.48E-04	9.16E-03	6.33E-03	2.75E-02	0.00E+00	9.7738E-01	1.0571E+02
α_4	2.31E-06	3.51E-03	1.18E-03	1.49E-02	0.00E+00	3.7439E-01	1.0631E+02
α_5	5.59E-21	6.77E-04	3.83E-07	3.92E-03	0.00E+00	7.2277E-02	1.0661E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9307110	0.9617830	0.9641380	0.9848000	0.9189380	1.2453E+02	4.9483E+00
α_2	6.03E-03	2.25E-02	2.01E-02	4.72E-02	8.11E-02	2.9088E+00	1.2657E+02
α_3	6.21E-04	8.82E-03	6.45E-03	2.51E-02	0.00E+00	1.1418E+00	1.2834E+02
α_4	4.09E-05	4.57E-03	2.40E-03	1.65E-02	0.00E+00	5.9222E-01	1.2889E+02
α_5	7.18E-09	1.72E-03	2.33E-04	8.60E-03	0.00E+00	2.2220E-01	1.2926E+02
α_6	1.09E-18	6.43E-04	1.12E-06	3.75E-03	0.00E+00	8.3237E-02	1.2940E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9388840	0.9630820	0.9646200	0.9820380	0.9010820	1.9259E+02	7.3825E+00
α_2	6.97E-03	2.01E-02	1.86E-02	3.87E-02	9.89E-02	4.0253E+00	1.9595E+02
α_3	1.10E-03	8.16E-03	6.59E-03	2.06E-02	0.00E+00	1.6312E+00	1.9834E+02
α_4	2.48E-04	4.95E-03	3.42E-03	1.48E-02	0.00E+00	9.8887E-01	1.9898E+02
α_5	1.28E-05	2.61E-03	1.24E-03	9.86E-03	0.00E+00	5.2177E-01	1.9945E+02
α_6	3.36E-10	9.32E-04	7.95E-05	4.89E-03	0.00E+00	1.8628E-01	1.9979E+02
α_7	0.00E+00	1.45E-04	1.27E-13	5.47E-04	0.00E+00	2.9071E-02	1.9994E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9411680	0.9632200	0.9645140	0.9808450	0.8826290	2.2813E+02	8.7110E+00
α_2	7.32E-03	1.94E-02	1.81E-02	3.60E-02	1.17E-01	4.5947E+00	2.3225E+02
α_3	1.09E-03	7.34E-03	6.01E-03	1.82E-02	0.00E+00	1.7384E+00	2.3510E+02
α_4	3.43E-04	4.84E-03	3.54E-03	1.38E-02	0.00E+00	1.1465E+00	2.3569E+02
α_5	5.44E-05	2.99E-03	1.76E-03	1.01E-02	0.00E+00	7.0833E-01	2.3613E+02
α_6	8.77E-07	1.55E-03	5.07E-04	6.63E-03	0.00E+00	3.6696E-01	2.3647E+02
α_7	6.88E-14	5.19E-04	9.34E-06	2.96E-03	0.00E+00	1.2297E-01	2.3672E+02
α_8	1.29E-42	1.40E-04	1.99E-12	5.91E-04	0.00E+00	3.3124E-02	2.3681E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9848060	0.9690830	0.9528530	0.9361240	0.9189380	0.9010820	0.8826290
α_2	1.52E-02	3.09E-02	4.71E-02	6.39E-02	8.11E-02	9.89E-02	1.17E-01
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.85E-01	9.69E-01	9.53E-01	9.36E-01	9.19E-01	9.01E-01	8.83E-01
Beta	1.52E-02	3.09E-02	4.71E-02	6.39E-02	8.11E-02	9.89E-02	1.17E-01
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	2.23	3.34	4.45	5.56	6.68	7.79	8.90
N_1	0.6607	0.8571	0.9643	0.9821	0.9107	0.7500	0.5000
N_2	0.0446	0.1339	0.2679	0.4464	0.6696	0.9375	1.2500
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.13 Generators

1.13.1 Emergency Diesel Generators

1.13.1.1 EMERGENCY DIESEL GENERATOR SPAR:DGN-FS

System :	Emergency power supply
Component :	Generator
Failure Mode :	Fail to start
Component Group :	Emergency Diesel Generator
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 231.40
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9769300	0.9893720	0.9906560	0.9974150	0.9907250	2.4525E+02	2.6345E+00
α_2	2.58E-03	1.06E-02	9.34E-03	2.31E-02	9.27E-03	2.6345E+00	2.4525E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9811990	0.9904960	0.9913330	0.9969430	0.9927790	3.8152E+02	3.6609E+00
α_2	1.34E-03	6.16E-03	5.33E-03	1.38E-02	4.34E-03	2.3737E+00	3.8281E+02
α_3	2.99E-04	3.34E-03	2.53E-03	9.15E-03	2.88E-03	1.2872E+00	3.8389E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9827040	0.9905690	0.9911890	0.9963150	0.9935420	5.1477E+02	4.9011E+00
α_2	1.29E-03	5.20E-03	4.58E-03	1.12E-02	3.12E-03	2.7001E+00	5.1697E+02
α_3	3.25E-04	2.84E-03	2.23E-03	7.43E-03	2.27E-03	1.4763E+00	5.1819E+02
α_4	2.75E-05	1.39E-03	8.29E-04	4.68E-03	1.06E-03	7.2467E-01	5.1895E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9825300	0.9895880	0.9900560	0.9950410	0.9938350	6.8122E+02	7.1675E+00
α_2	1.84E-03	5.55E-03	5.08E-03	1.09E-02	2.90E-03	3.8222E+00	6.8457E+02
α_3	4.54E-04	2.74E-03	2.28E-03	6.62E-03	1.55E-03	1.8894E+00	6.8650E+02
α_4	1.13E-04	1.65E-03	1.20E-03	4.72E-03	1.29E-03	1.1334E+00	6.8725E+02
α_5	9.50E-08	4.68E-04	1.28E-04	2.09E-03	4.25E-04	3.2248E-01	6.8807E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9832600	0.9896420	0.9900320	0.9946860	0.9939260	8.1823E+02	8.5639E+00
α_2	1.89E-03	5.24E-03	4.85E-03	9.93E-03	2.97E-03	4.3325E+00	8.2246E+02
α_3	3.99E-04	2.34E-03	1.95E-03	5.60E-03	1.12E-03	1.9334E+00	8.2486E+02
α_4	1.65E-04	1.65E-03	1.27E-03	4.44E-03	1.10E-03	1.3665E+00	8.2543E+02
α_5	1.71E-05	8.75E-04	5.19E-04	2.94E-03	7.10E-04	7.2330E-01	8.2607E+02
α_6	4.49E-10	2.52E-04	2.90E-05	1.28E-03	1.77E-04	2.0824E-01	8.2659E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9907250	0.9927790	0.9935420	0.9938350	0.9939260
α_2	9.27E-03	4.34E-03	3.12E-03	2.90E-03	2.97E-03
α_3		2.88E-03	2.27E-03	1.55E-03	1.12E-03
α_4			1.06E-03	1.29E-03	1.10E-03
α_5				4.25E-04	7.10E-04
α_6					1.77E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.91E-01	9.93E-01	9.94E-01	9.94E-01	9.94E-01
Beta	9.27E-03	7.22E-03	6.46E-03	6.16E-03	6.07E-03
Gamma		3.98E-01	5.17E-01	5.29E-01	5.12E-01
Delta			3.19E-01	5.25E-01	6.39E-01
Epsilon				2.48E-01	4.47E-01
Mu					2.00E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	231.40	347.10	462.80	578.50	694.20
N_1	3.6000	4.8600	5.8320	6.5610	7.0859
N_2	2.2000	1.5400	1.4720	1.7080	2.0933
N_3		1.0200	1.0720	0.9120	0.7916
N_4			0.5020	0.7590	0.7743
N_5				0.2502	0.5011
N_6					0.1250

1.13.1.2 EMERGENCY DIESEL GENERATOR SPAR:DGN-LR

System :	Emergency power supply
Component :	Generator
Failure Mode :	Fail to Load/Run
Component Group :	Emergency Diesel Generator
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 239.60
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9815060	0.9946810	0.9970150	0.9999230	0.9980370	1.2258E+02	6.5552E-01
α_2	7.26E-05	5.32E-03	2.99E-03	1.85E-02	1.96E-03	6.5552E-01	1.2258E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9783260	0.9912080	0.9927870	0.9986810	0.9961410	1.9741E+02	1.7511E+00
α_2	8.53E-04	7.42E-03	5.85E-03	1.94E-02	3.82E-03	1.4775E+00	1.9768E+02
α_3	6.07E-08	1.37E-03	2.87E-04	6.47E-03	3.80E-05	2.7362E-01	1.9889E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9762530	0.9884950	0.9896710	0.9967240	0.9943050	2.6912E+02	3.1323E+00
α_2	2.08E-03	9.12E-03	7.95E-03	2.02E-02	5.59E-03	2.4822E+00	2.6977E+02
α_3	2.48E-06	1.57E-03	6.12E-04	6.36E-03	9.94E-05	4.2661E-01	2.7183E+02
α_4	3.68E-09	8.21E-04	1.13E-04	4.11E-03	3.57E-06	2.2347E-01	2.7203E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9761280	0.9869290	0.9877770	0.9948430	0.9949130	3.7470E+02	4.9625E+00
α_2	2.37E-03	8.30E-03	7.45E-03	1.71E-02	3.70E-03	3.1513E+00	3.7651E+02
α_3	3.56E-04	3.58E-03	2.76E-03	9.63E-03	1.37E-03	1.3608E+00	3.7830E+02
α_4	6.98E-07	9.96E-04	3.38E-04	4.22E-03	1.29E-05	3.7799E-01	3.7928E+02
α_5	1.66E-21	1.91E-04	1.09E-07	1.10E-03	3.57E-07	7.2377E-02	3.7959E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9775260	0.9872010	0.9879080	0.9944710	0.9953260	4.5102E+02	5.8475E+00
α_2	1.97E-03	6.89E-03	6.19E-03	1.42E-02	2.71E-03	3.1483E+00	4.5372E+02
α_3	5.15E-04	3.67E-03	2.98E-03	9.21E-03	1.60E-03	1.6786E+00	4.5519E+02
α_4	2.93E-05	1.56E-03	9.22E-04	5.28E-03	3.64E-04	7.1442E-01	4.5615E+02
α_5	2.12E-09	4.88E-04	6.64E-05	2.44E-03	2.09E-06	2.2290E-01	4.5664E+02
α_6	3.08E-19	1.82E-04	3.18E-07	1.06E-03	0.00E+00	8.3237E-02	4.5678E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9980370	0.9961410	0.9943050	0.9949130	0.9953260
α_2	1.96E-03	3.82E-03	5.59E-03	3.70E-03	2.71E-03
α_3		3.80E-05	9.94E-05	1.37E-03	1.60E-03
α_4			3.57E-06	1.29E-05	3.64E-04
α_5				3.57E-07	2.09E-06
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.98E-01	9.96E-01	9.94E-01	9.95E-01	9.95E-01
Beta	1.96E-03	3.86E-03	5.70E-03	5.09E-03	4.67E-03
Gamma		9.84E-03	1.81E-02	2.72E-01	4.21E-01
Delta			3.46E-02	9.56E-03	1.86E-01
Epsilon				2.70E-02	5.70E-03
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	110.67	166.00	221.34	276.67	332.01
N_1	1.6680	1.8582	1.6415	1.8682	2.0684
N_2	0.2210	0.6438	1.2541	1.0371	0.9091
N_3		0.0064	0.0223	0.3834	0.5368
N_4			0.0008	0.0036	0.1222
N_5				0.0001	0.0007
N_6					0.0000

1.13.1.3 EMERGENCY DIESEL GENERATOR SPAR:DGN-FR

System :	Emergency power supply
Component :	Generator
Failure Mode :	Fail to Run (Normally running equipment)
Component Group :	Emergency Diesel Generator
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 166.80
Total Number of Common-Cause Failure Events: 5

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9612660	0.9823760	0.9845930	0.9959220	0.9842540	1.3938E+02	2.5005E+00
α_2	4.08E-03	1.76E-02	1.54E-02	3.87E-02	1.57E-02	2.5005E+00	1.3938E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9704940	0.9855010	0.9869080	0.9957050	0.9888550	2.2308E+02	3.2821E+00
α_2	1.59E-03	8.86E-03	7.46E-03	2.09E-02	5.99E-03	2.0065E+00	2.2436E+02
α_3	4.97E-04	5.64E-03	4.26E-03	1.55E-02	5.15E-03	1.2756E+00	2.2509E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9740960	0.9864140	0.9874540	0.9951800	0.9910380	3.0398E+02	4.1869E+00
α_2	1.20E-03	6.59E-03	5.55E-03	1.55E-02	3.08E-03	2.0294E+00	3.0614E+02
α_3	5.07E-04	4.65E-03	3.63E-03	1.23E-02	3.96E-03	1.4338E+00	3.0673E+02
α_4	4.61E-05	2.35E-03	1.40E-03	7.89E-03	1.93E-03	7.2367E-01	3.0744E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9751810	0.9857520	0.9865070	0.9937420	0.9922770	4.1824E+02	6.0451E+00
α_2	1.70E-03	6.60E-03	5.85E-03	1.41E-02	2.12E-03	2.8016E+00	4.2148E+02
α_3	6.51E-04	4.22E-03	3.48E-03	1.04E-02	2.51E-03	1.7922E+00	4.2249E+02
α_4	1.82E-04	2.66E-03	1.93E-03	7.63E-03	2.32E-03	1.1289E+00	4.2316E+02
α_5	1.54E-07	7.60E-04	2.08E-04	3.40E-03	7.71E-04	3.2238E-01	4.2396E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9769790	0.9863600	0.9869890	0.9935890	0.9931090	5.0323E+02	6.9588E+00
α_2	1.52E-03	5.71E-03	5.08E-03	1.21E-02	1.73E-03	2.9125E+00	5.0728E+02
α_3	5.18E-04	3.45E-03	2.83E-03	8.51E-03	1.59E-03	1.7595E+00	5.0843E+02
α_4	2.62E-04	2.66E-03	2.04E-03	7.15E-03	1.96E-03	1.3556E+00	5.0883E+02
α_5	2.77E-05	1.42E-03	8.42E-04	4.76E-03	1.29E-03	7.2300E-01	5.0947E+02
α_6	7.28E-10	4.08E-04	4.71E-05	2.08E-03	3.21E-04	2.0824E-01	5.0998E+02

ALPHA FACTOR and MGL PARAMETERS

EMERGENCY DIESEL GENERATOR SPAR:DGN-FR

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9842540	0.9888550	0.9910380	0.9922770	0.9931090
α_2	1.57E-02	5.99E-03	3.08E-03	2.12E-03	1.73E-03
α_3		5.15E-03	3.96E-03	2.51E-03	1.59E-03
α_4			1.93E-03	2.32E-03	1.96E-03
α_5				7.71E-04	1.29E-03
α_6					3.21E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.84E-01	9.89E-01	9.91E-01	9.92E-01	9.93E-01
Beta	1.57E-02	1.11E-02	8.96E-03	7.72E-03	6.89E-03
Gamma		4.62E-01	6.56E-01	7.26E-01	7.49E-01
Delta			3.27E-01	5.52E-01	6.92E-01
Epsilon				2.49E-01	4.50E-01
Mu					2.00E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	128.31	192.46	256.62	320.77	384.92
N_1	0.8280	1.0692	1.2247	1.3122	1.3666
N_2	2.0660	1.1728	0.8013	0.6874	0.6733
N_3		1.0084	1.0295	0.8148	0.6177
N_4			0.5010	0.7545	0.7634
N_5				0.2501	0.5008
N_6					0.1250

1.14 Vacuum Breakers

1.14.1 BWR Pressure Suppression Vacuum Breakers

1.14.1.1 CONTAINMENT VACUUM RELIEF CHECK FAIL TO OPEN

System : Vapor suppression
Component : Vacuum Breaker
Failure Mode : Fail to open on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 8.50
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8655120	0.9618620	0.9790560	0.9996170	0.9672070	1.5163E+01	6.0122E-01
α_2	3.81E-04	3.81E-02	2.09E-02	1.34E-01	3.28E-02	6.0122E-01	1.5163E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8948480	0.9579100	0.9656850	0.9943410	0.9322490	3.6435E+01	1.6009E+00
α_2	3.45E-03	3.51E-02	2.73E-02	9.34E-02	6.78E-02	1.3337E+00	3.6702E+01
α_3	2.47E-07	7.03E-03	1.42E-03	3.33E-02	0.00E+00	2.6722E-01	3.7769E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8963600	0.9503390	0.9554910	0.9866900	0.8947370	5.4636E+01	2.8551E+00
α_2	8.03E-03	3.88E-02	3.35E-02	8.74E-02	1.05E-01	2.2281E+00	5.5263E+01
α_3	7.93E-06	7.03E-03	2.61E-03	2.90E-02	0.00E+00	4.0431E-01	5.7087E+01
α_4	1.67E-08	3.87E-03	5.31E-04	1.94E-02	0.00E+00	2.2267E-01	5.7268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9245680	0.9592350	0.9619630	0.9845880	0.9140150	1.0679E+02	4.5383E+00
α_2	6.44E-03	2.50E-02	2.22E-02	5.31E-02	5.73E-02	2.7809E+00	1.0855E+02
α_3	1.10E-03	1.18E-02	9.00E-03	3.19E-02	2.87E-02	1.3107E+00	1.1002E+02
α_4	2.21E-06	3.36E-03	1.13E-03	1.43E-02	0.00E+00	3.7439E-01	1.1095E+02
α_5	5.36E-21	6.49E-04	3.67E-07	3.76E-03	0.00E+00	7.2277E-02	1.1126E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9302070	0.9608900	0.9631520	0.9838510	0.9272790	1.2969E+02	5.2786E+00
α_2	4.94E-03	1.99E-02	1.76E-02	4.28E-02	3.23E-02	2.6836E+00	1.3228E+02
α_3	1.52E-03	1.18E-02	9.44E-03	2.99E-02	3.23E-02	1.5862E+00	1.3338E+02
α_4	9.27E-05	5.21E-03	3.06E-03	1.77E-02	8.08E-03	7.0332E-01	1.3427E+02
α_5	6.88E-09	1.65E-03	2.23E-04	8.25E-03	0.00E+00	2.2220E-01	1.3475E+02
α_6	1.04E-18	6.17E-04	1.08E-06	3.60E-03	0.00E+00	8.3237E-02	1.3489E+02

ALPHA FACTOR and MGL PARAMETERS

CONTAINMENT VACUUM RELIEF CHECK FAIL TO OPEN

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9672070	0.9322490	0.8947370	0.9140150	0.9272790
α_2	3.28E-02	6.78E-02	1.05E-01	5.73E-02	3.23E-02
α_3		0.00E+00	0.00E+00	2.87E-02	3.23E-02
α_4			0.00E+00	0.00E+00	8.08E-03
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.67E-01	9.32E-01	8.95E-01	9.14E-01	9.27E-01
Beta	3.28E-02	6.78E-02	1.05E-01	8.60E-02	7.27E-02
Gamma		0.00E+00	0.00E+00	3.33E-01	5.56E-01
Delta			0.00E+00	0.00E+00	2.00E-01
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	4.25	6.38	8.50	10.63	12.75
N_1	0.6667	0.5000	0.0000	0.0000	0.0000
N_2	0.1667	0.5000	1.0000	0.6667	0.4444
N_3		0.0000	0.0000	0.3333	0.4444
N_4			0.0000	0.0000	0.1111
N_5				0.0000	0.0000
N_6					0.0000

1.15 AC Power Distribution Breakers

1.15.1480 Vac Circuit Breakers

1.15.1.1 480 V CIRCUIT BREAKERS FAIL TO OPEN

System :	Plant ac power
Component :	Circuit Breaker
Failure Mode :	Fail to open on demand
Component Group :	480 Volt
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 25.20
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8733290	0.9673880	0.9854840	0.9999110	0.9914570	1.3797E+01	4.6512E-01
α_2	9.09E-05	3.26E-02	1.45E-02	1.27E-01	8.54E-03	4.6512E-01	1.3797E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9086520	0.9671070	0.9753210	0.9974450	0.9844460	3.4808E+01	1.1839E+00
α_2	1.05E-03	2.53E-02	1.72E-02	7.74E-02	1.47E-02	9.1226E-01	3.5080E+01
α_3	3.14E-07	7.55E-03	1.57E-03	3.56E-02	8.25E-04	2.7162E-01	3.5720E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9150550	0.9635700	0.9690450	0.9933460	0.9786920	5.3044E+01	2.0055E+00
α_2	2.51E-03	2.48E-02	1.93E-02	6.58E-02	1.91E-02	1.3628E+00	5.3687E+01
α_3	1.09E-05	7.62E-03	2.95E-03	3.11E-02	2.14E-03	4.1941E-01	5.4630E+01
α_4	1.81E-08	4.06E-03	5.60E-04	2.03E-02	8.50E-05	2.2327E-01	5.4826E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9324610	0.9652880	0.9681150	0.9884530	0.9741080	1.0471E+02	3.7654E+00
α_2	4.53E-03	2.13E-02	1.84E-02	4.78E-02	2.19E-02	2.3062E+00	1.0617E+02
α_3	4.94E-04	9.31E-03	6.52E-03	2.77E-02	3.69E-03	1.0098E+00	1.0747E+02
α_4	2.40E-06	3.48E-03	1.18E-03	1.47E-02	2.96E-04	3.7699E-01	1.0810E+02
α_5	5.83E-21	6.67E-04	3.82E-07	3.86E-03	1.14E-05	7.2377E-02	1.0840E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9355710	0.9651590	0.9674890	0.9867730	0.9704420	1.2709E+02	4.5878E+00
α_2	4.35E-03	1.89E-02	1.65E-02	4.15E-02	2.35E-02	2.4854E+00	1.2919E+02
α_3	7.09E-04	9.09E-03	6.76E-03	2.55E-02	5.33E-03	1.1975E+00	1.3048E+02
α_4	4.28E-05	4.55E-03	2.40E-03	1.63E-02	6.50E-04	5.9902E-01	1.3108E+02
α_5	7.23E-09	1.69E-03	2.30E-04	8.47E-03	3.83E-05	2.2260E-01	1.3146E+02
α_6	1.07E-18	6.32E-04	1.11E-06	3.69E-03	0.00E+00	8.3237E-02	1.3159E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9431480	0.9662530	0.9677740	0.9841510	0.9675950	1.9580E+02	6.8384E+00
α_2	5.07E-03	1.67E-02	1.51E-02	3.37E-02	2.43E-02	3.3822E+00	1.9926E+02
α_3	1.23E-03	8.46E-03	6.91E-03	2.10E-02	6.90E-03	1.7150E+00	2.0092E+02
α_4	2.57E-04	4.95E-03	3.44E-03	1.48E-02	1.14E-03	1.0027E+00	2.0164E+02
α_5	1.29E-05	2.58E-03	1.22E-03	9.75E-03	1.07E-04	5.2307E-01	2.0212E+02
α_6	3.35E-10	9.20E-04	7.87E-05	4.83E-03	8.24E-06	1.8638E-01	2.0245E+02
α_7	0.00E+00	1.43E-04	1.26E-13	5.40E-04	0.00E+00	2.9071E-02	2.0261E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9460220	0.9669230	0.9682150	0.9834230	0.9654290	2.3205E+02	7.9381E+00
α_2	4.97E-03	1.53E-02	1.40E-02	3.02E-02	2.43E-02	3.6798E+00	2.3631E+02
α_3	1.25E-03	7.72E-03	6.40E-03	1.87E-02	8.33E-03	1.8534E+00	2.3813E+02
α_4	3.61E-04	4.88E-03	3.59E-03	1.38E-02	1.72E-03	1.1703E+00	2.3882E+02
α_5	5.48E-05	2.96E-03	1.75E-03	1.00E-02	2.17E-04	7.1133E-01	2.3928E+02
α_6	8.69E-07	1.53E-03	5.01E-04	6.54E-03	1.45E-05	3.6716E-01	2.3962E+02
α_7	6.79E-14	5.12E-04	9.21E-06	2.92E-03	0.00E+00	1.2297E-01	2.3987E+02
α_8	1.27E-42	1.38E-04	1.97E-12	5.83E-04	0.00E+00	3.3124E-02	2.3995E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9914570	0.9844460	0.9786920	0.9741080	0.9704420	0.9675950	0.9654290
α_2	8.54E-03	1.47E-02	1.91E-02	2.19E-02	2.35E-02	2.43E-02	2.43E-02
α_3		8.25E-04	2.14E-03	3.69E-03	5.33E-03	6.90E-03	8.33E-03
α_4			8.50E-05	2.96E-04	6.50E-04	1.14E-03	1.72E-03
α_5				1.14E-05	3.83E-05	1.07E-04	2.17E-04
α_6					0.00E+00	8.24E-06	1.45E-05
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.91E-01	9.84E-01	9.79E-01	9.74E-01	9.70E-01	9.68E-01	9.65E-01
Beta	8.54E-03	1.56E-02	2.13E-02	2.59E-02	2.96E-02	3.24E-02	3.46E-02
Gamma		5.30E-02	1.04E-01	1.55E-01	2.03E-01	2.52E-01	2.98E-01
Delta			3.82E-02	7.69E-02	1.14E-01	1.54E-01	1.90E-01
Epsilon				3.70E-02	5.56E-02	9.21E-02	1.19E-01
Mu					0.00E+00	7.14E-02	6.25E-02
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	3.15	4.73	6.30	7.88	9.45	11.03	12.60
N_1	0.4013	0.5234	0.6081	0.6641	0.6984	0.7167	0.7233
N_2	0.0306	0.0786	0.1347	0.1920	0.2462	0.2944	0.3351
N_3		0.0044	0.0151	0.0324	0.0557	0.0838	0.1150
N_4			0.0006	0.0026	0.0068	0.0138	0.0238
N_5				0.0001	0.0004	0.0013	0.0030
N_6					0.0000	0.0001	0.0002
N_7						0.0000	0.0000
N_8							0.0000

1.15.1.2 480 V CIRCUIT BREAKERS FAIL TO CLOSE

System :	Plant ac power
Component :	Circuit Breaker
Failure Mode :	Fail to close (reseat) on demand
Component Group :	480 Volt
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 55.20
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8996800	0.9743720	0.9888280	0.9999300	0.9965520	1.7471E+01	4.5952E-01
α_2	6.59E-05	2.56E-02	1.12E-02	1.00E-01	3.45E-03	4.5952E-01	1.7471E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9210900	0.9717490	0.9789250	0.9978550	0.9934130	4.0323E+01	1.1723E+00
α_2	8.74E-04	2.18E-02	1.47E-02	6.69E-02	6.42E-03	9.0326E-01	4.0592E+01
α_3	2.44E-07	6.48E-03	1.33E-03	3.07E-02	1.66E-04	2.6902E-01	4.1226E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9252820	0.9680950	0.9729650	0.9942450	0.9905810	6.0407E+01	1.9908E+00
α_2	2.18E-03	2.17E-02	1.69E-02	5.80E-02	8.93E-03	1.3567E+00	6.1041E+01
α_3	8.33E-06	6.59E-03	2.49E-03	2.71E-02	4.93E-04	4.1141E-01	6.1986E+01
α_4	1.54E-08	3.57E-03	4.89E-04	1.79E-02	0.00E+00	2.2267E-01	6.2175E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9378210	0.9681050	0.9707210	0.9894300	0.9880650	1.1390E+02	3.7525E+00
α_2	4.19E-03	1.96E-02	1.70E-02	4.42E-02	1.09E-02	2.3106E+00	1.1534E+02
α_3	4.32E-04	8.46E-03	5.89E-03	2.53E-02	9.97E-04	9.9528E-01	1.1666E+02
α_4	2.09E-06	3.18E-03	1.07E-03	1.35E-02	0.00E+00	3.7439E-01	1.1728E+02
α_5	5.07E-21	6.14E-04	3.47E-07	3.56E-03	0.00E+00	7.2277E-02	1.1758E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9405480	0.9678890	0.9700510	0.9878320	0.9858700	1.3812E+02	4.5823E+00
α_2	4.08E-03	1.76E-02	1.54E-02	3.86E-02	1.25E-02	2.5071E+00	1.4020E+02
α_3	6.20E-04	8.25E-03	6.10E-03	2.32E-02	1.66E-03	1.1775E+00	1.4152E+02
α_4	3.71E-05	4.15E-03	2.17E-03	1.50E-02	0.00E+00	5.9222E-01	1.4211E+02
α_5	6.51E-09	1.56E-03	2.11E-04	7.80E-03	0.00E+00	2.2220E-01	1.4248E+02
α_6	9.88E-19	5.83E-04	1.02E-06	3.40E-03	0.00E+00	8.3237E-02	1.4262E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9464750	0.9682360	0.9696730	0.9850820	0.9840000	2.0865E+02	6.8450E+00
α_2	4.88E-03	1.59E-02	1.44E-02	3.19E-02	1.35E-02	3.4253E+00	2.1207E+02
α_3	1.12E-03	7.86E-03	6.40E-03	1.96E-02	2.50E-03	1.6937E+00	2.1380E+02
α_4	2.30E-04	4.59E-03	3.18E-03	1.38E-02	0.00E+00	9.8887E-01	2.1451E+02
α_5	1.19E-05	2.42E-03	1.15E-03	9.15E-03	0.00E+00	5.2177E-01	2.1497E+02
α_6	3.12E-10	8.64E-04	7.38E-05	4.54E-03	0.00E+00	1.8628E-01	2.1531E+02
α_7	0.00E+00	1.35E-04	1.18E-13	5.08E-04	0.00E+00	2.9071E-02	2.1547E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9489980	0.9687430	0.9699610	0.9843260	0.9824560	2.4673E+02	7.9610E+00
α_2	4.82E-03	1.47E-02	1.35E-02	2.89E-02	1.40E-02	3.7447E+00	2.5095E+02
α_3	1.15E-03	7.22E-03	5.98E-03	1.75E-02	3.51E-03	1.8384E+00	2.5285E+02
α_4	3.19E-04	4.50E-03	3.29E-03	1.28E-02	0.00E+00	1.1465E+00	2.5354E+02
α_5	5.06E-05	2.78E-03	1.63E-03	9.41E-03	0.00E+00	7.0833E-01	2.5398E+02
α_6	8.15E-07	1.44E-03	4.72E-04	6.16E-03	0.00E+00	3.6696E-01	2.5432E+02
α_7	6.39E-14	4.83E-04	8.68E-06	2.75E-03	0.00E+00	1.2297E-01	2.5457E+02
α_8	1.20E-42	1.30E-04	1.85E-12	5.50E-04	0.00E+00	3.3124E-02	2.5466E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9965520	0.9934130	0.9905810	0.9880650	0.9858700	0.9840000	0.9824560
α_2	3.45E-03	6.42E-03	8.93E-03	1.09E-02	1.25E-02	1.35E-02	1.40E-02
α_3		1.66E-04	4.93E-04	9.97E-04	1.66E-03	2.50E-03	3.51E-03
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.97E-01	9.93E-01	9.91E-01	9.88E-01	9.86E-01	9.84E-01	9.82E-01
Beta	3.45E-03	6.59E-03	9.42E-03	1.19E-02	1.41E-02	1.60E-02	1.75E-02
Gamma		2.52E-02	5.23E-02	8.35E-02	1.18E-01	1.56E-01	2.00E-01
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	6.90	10.35	13.80	17.25	20.70	24.15	27.60
N_1	0.3250	0.4179	0.4714	0.4911	0.4821	0.4500	0.4000
N_2	0.0250	0.0696	0.1286	0.1964	0.2679	0.3375	0.4000
N_3		0.0018	0.0071	0.0179	0.0357	0.0625	0.1000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.15.1.3 480 V CIRCUIT BREAKERS SPURIOUS ACTUATION

System :	Plant ac power
Component :	Circuit Breaker
Failure Mode :	Spurious operation open or close
Component Group :	480 Volt
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 56.20
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9738350	0.9935030	0.9973920	0.9999870	1.0000000	6.6446E+01	4.3452E-01
α_2	1.16E-05	6.50E-03	2.61E-03	2.62E-02	0.00E+00	4.3452E-01	6.6446E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9635220	0.9873250	0.9908250	0.9991710	1.0000000	8.5755E+01	1.1009E+00
α_2	3.02E-04	9.60E-03	6.19E-03	3.05E-02	0.00E+00	8.3366E-01	8.6022E+01
α_3	1.07E-07	3.08E-03	6.17E-04	1.46E-02	0.00E+00	2.6722E-01	8.6589E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9570890	0.9821960	0.9851810	0.9970990	1.0000000	1.0234E+02	1.8551E+00
α_2	9.69E-04	1.18E-02	8.84E-03	3.27E-02	0.00E+00	1.2281E+00	1.0297E+02
α_3	4.35E-06	3.88E-03	1.43E-03	1.60E-02	0.00E+00	4.0431E-01	1.0379E+02
α_4	9.19E-09	2.14E-03	2.92E-04	1.07E-02	0.00E+00	2.2267E-01	1.0397E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9549040	0.9773040	0.9793180	0.9928370	1.0000000	1.5236E+02	3.5382E+00
α_2	2.60E-03	1.36E-02	1.15E-02	3.14E-02	0.00E+00	2.1142E+00	1.5378E+02
α_3	3.05E-04	6.27E-03	4.32E-03	1.89E-02	0.00E+00	9.7738E-01	1.5492E+02
α_4	1.58E-06	2.40E-03	8.08E-04	1.02E-02	0.00E+00	3.7439E-01	1.5552E+02
α_5	3.82E-21	4.64E-04	2.62E-07	2.68E-03	0.00E+00	7.2277E-02	1.5583E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9544430	0.9758840	0.9776540	0.9912880	1.0000000	1.7314E+02	4.2787E+00
α_2	2.59E-03	1.26E-02	1.08E-02	2.87E-02	0.00E+00	2.2392E+00	1.7518E+02
α_3	4.52E-04	6.44E-03	4.70E-03	1.83E-02	0.00E+00	1.1418E+00	1.7628E+02
α_4	2.98E-05	3.34E-03	1.75E-03	1.20E-02	0.00E+00	5.9222E-01	1.7683E+02
α_5	5.23E-09	1.25E-03	1.70E-04	6.27E-03	0.00E+00	2.2220E-01	1.7720E+02
α_6	7.94E-19	4.69E-04	8.20E-07	2.74E-03	0.00E+00	8.3237E-02	1.7734E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9553070	0.9738750	0.9751480	0.9881010	1.0000000	2.4025E+02	6.4450E+00
α_2	3.52E-03	1.25E-02	1.12E-02	2.59E-02	0.00E+00	3.0878E+00	2.4361E+02
α_3	8.90E-04	6.61E-03	5.34E-03	1.67E-02	0.00E+00	1.6312E+00	2.4506E+02
α_4	2.01E-04	4.01E-03	2.77E-03	1.20E-02	0.00E+00	9.8887E-01	2.4571E+02
α_5	1.04E-05	2.12E-03	1.00E-03	7.99E-03	0.00E+00	5.2177E-01	2.4617E+02
α_6	2.72E-10	7.55E-04	6.44E-05	3.96E-03	0.00E+00	1.8628E-01	2.4651E+02
α_7	0.00E+00	1.18E-04	1.03E-13	4.43E-04	0.00E+00	2.9071E-02	2.4667E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9562380	0.9735790	0.9746920	0.9871310	1.0000000	2.7493E+02	7.4610E+00
α_2	3.56E-03	1.18E-02	1.07E-02	2.40E-02	0.00E+00	3.3447E+00	2.7905E+02
α_3	9.10E-04	6.16E-03	5.04E-03	1.52E-02	0.00E+00	1.7384E+00	2.8065E+02
α_4	2.87E-04	4.06E-03	2.97E-03	1.16E-02	0.00E+00	1.1465E+00	2.8124E+02
α_5	4.56E-05	2.51E-03	1.47E-03	8.49E-03	0.00E+00	7.0833E-01	2.8168E+02
α_6	7.35E-07	1.30E-03	4.25E-04	5.56E-03	0.00E+00	3.6696E-01	2.8202E+02
α_7	5.76E-14	4.35E-04	7.83E-06	2.48E-03	0.00E+00	1.2297E-01	2.8227E+02
α_8	1.08E-42	1.17E-04	1.67E-12	4.96E-04	0.00E+00	3.3124E-02	2.8236E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	56.20	56.20	56.20	56.20	56.20	56.20	56.20
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.15.24160 vac and 6.9Kva Distribution Circuit Breakers

1.15.2.1 ACP 4160 AND 6.9 CIRCUIT BREAKERS FAIL TO OPEN SPAR: CRB-CC

System :	Plant ac power
Component :	Circuit Breaker
Failure Mode :	Fail to open on demand
Component Group :	4160 - 6900 Volt
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 15.10
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8684700	0.9657950	0.9843870	0.9998920	0.9869830	1.3469E+01	4.7702E-01
α_2	1.10E-04	3.42E-02	1.56E-02	1.32E-01	1.30E-02	4.7702E-01	1.3469E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9052000	0.9654050	0.9737310	0.9971010	0.9737490	3.4262E+01	1.2278E+00
α_2	1.29E-03	2.71E-02	1.88E-02	8.11E-02	2.62E-02	9.6026E-01	3.4530E+01
α_3	2.68E-07	7.54E-03	1.53E-03	3.57E-02	6.21E-05	2.6752E-01	3.5222E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9110430	0.9612170	0.9667470	0.9924650	0.9602440	5.2235E+01	2.1076E+00
α_2	3.19E-03	2.72E-02	2.17E-02	7.03E-02	3.96E-02	1.4793E+00	5.2863E+01
α_3	8.60E-06	7.46E-03	2.78E-03	3.08E-02	2.05E-04	4.0561E-01	5.3937E+01
α_4	1.77E-08	4.10E-03	5.62E-04	2.05E-02	0.00E+00	2.2267E-01	5.4120E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9293860	0.9632040	0.9660450	0.9873100	0.9465730	1.0358E+02	3.9569E+00
α_2	5.53E-03	2.35E-02	2.06E-02	5.14E-02	5.30E-02	2.5299E+00	1.0501E+02
α_3	4.49E-04	9.12E-03	6.31E-03	2.74E-02	3.83E-04	9.8038E-01	1.0656E+02
α_4	2.29E-06	3.48E-03	1.17E-03	1.48E-02	0.00E+00	3.7439E-01	1.0716E+02
α_5	5.55E-21	6.72E-04	3.80E-07	3.89E-03	0.00E+00	7.2277E-02	1.0746E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9317100	0.9624250	0.9647650	0.9851340	0.9326590	1.2560E+02	4.9037E+00
α_2	5.78E-03	2.19E-02	1.95E-02	4.62E-02	6.67E-02	2.8582E+00	1.2765E+02
α_3	6.26E-04	8.79E-03	6.44E-03	2.50E-02	6.36E-04	1.1477E+00	1.2936E+02
α_4	4.06E-05	4.54E-03	2.38E-03	1.64E-02	1.08E-05	5.9232E-01	1.2991E+02
α_5	7.12E-09	1.70E-03	2.31E-04	8.53E-03	0.00E+00	2.2220E-01	1.3028E+02
α_6	1.08E-18	6.38E-04	1.12E-06	3.72E-03	0.00E+00	8.3237E-02	1.3042E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9396710	0.9636340	0.9651640	0.9823800	0.9184810	1.9386E+02	7.3160E+00
α_2	6.70E-03	1.96E-02	1.81E-02	3.79E-02	8.05E-02	3.9484E+00	1.9723E+02
α_3	1.11E-03	8.16E-03	6.60E-03	2.05E-02	9.45E-04	1.6413E+00	1.9953E+02
α_4	2.47E-04	4.92E-03	3.40E-03	1.48E-02	2.81E-05	9.8917E-01	2.0019E+02
α_5	1.28E-05	2.59E-03	1.23E-03	9.80E-03	0.00E+00	5.2177E-01	2.0065E+02
α_6	3.34E-10	9.26E-04	7.91E-05	4.86E-03	0.00E+00	1.8628E-01	2.0099E+02
α_7	0.00E+00	1.45E-04	1.27E-13	5.44E-04	0.00E+00	2.9071E-02	2.0115E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9420080	0.9638310	0.9651240	0.9812460	0.9040530	2.2962E+02	8.6169E+00
α_2	7.00E-03	1.88E-02	1.75E-02	3.52E-02	9.46E-02	4.4843E+00	2.3375E+02
α_3	1.10E-03	7.36E-03	6.04E-03	1.82E-02	1.30E-03	1.7541E+00	2.3648E+02
α_4	3.41E-04	4.81E-03	3.52E-03	1.37E-02	4.98E-05	1.1471E+00	2.3709E+02
α_5	5.41E-05	2.97E-03	1.75E-03	1.01E-02	0.00E+00	7.0833E-01	2.3753E+02
α_6	8.72E-07	1.54E-03	5.04E-04	6.59E-03	0.00E+00	3.6696E-01	2.3787E+02
α_7	6.84E-14	5.16E-04	9.28E-06	2.94E-03	0.00E+00	1.2297E-01	2.3811E+02
α_8	1.28E-42	1.39E-04	1.98E-12	5.88E-04	0.00E+00	3.3124E-02	2.3820E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9869830	0.9737490	0.9602440	0.9465730	0.9326590	0.9184810	0.9040530
α_2	1.30E-02	2.62E-02	3.96E-02	5.30E-02	6.67E-02	8.05E-02	9.46E-02
α_3		6.21E-05	2.05E-04	3.83E-04	6.36E-04	9.45E-04	1.30E-03
α_4			0.00E+00	0.00E+00	1.08E-05	2.81E-05	4.98E-05
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.87E-01	9.74E-01	9.60E-01	9.47E-01	9.33E-01	9.18E-01	9.04E-01
Beta	1.30E-02	2.63E-02	3.98E-02	5.34E-02	6.73E-02	8.15E-02	9.59E-02
Gamma		2.36E-03	5.15E-03	7.17E-03	9.60E-03	1.19E-02	1.41E-02
Delta			0.00E+00	0.00E+00	1.67E-02	2.88E-02	3.68E-02
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	2.52	3.78	5.03	6.29	7.55	8.81	10.07
N_1	0.7025	0.9272	1.0688	1.1281	1.1061	1.0036	0.8214
N_2	0.0425	0.1266	0.2512	0.4157	0.6190	0.8606	1.1396
N_3		0.0003	0.0013	0.0030	0.0059	0.0101	0.0157
N_4			0.0000	0.0000	0.0001	0.0003	0.0006
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.15.2.2 ACP 4160 AND 6.9 CIRCUIT BREAKERS FAIL TO CLOSE SPAR: CRB-OO

System :	Plant ac power
Component :	Circuit Breaker
Failure Mode :	Fail to close (reseat) on demand
Component Group :	4160 - 6900 Volt
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 64.30
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9766590	0.9942050	0.9976810	0.9999910	1.0000000	7.4546E+01	4.3452E-01
α_2	1.03E-05	5.80E-03	2.32E-03	2.33E-02	0.00E+00	4.3452E-01	7.4546E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9666200	0.9884060	0.9916130	0.9992420	1.0000000	9.3855E+01	1.1009E+00
α_2	2.76E-04	8.78E-03	5.66E-03	2.79E-02	0.00E+00	8.3366E-01	9.4122E+01
α_3	9.79E-08	2.81E-03	5.64E-04	1.33E-02	0.00E+00	2.6722E-01	9.4689E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9601610	0.9834800	0.9862570	0.9973110	1.0000000	1.1044E+02	1.8551E+00
α_2	8.98E-04	1.09E-02	8.20E-03	3.03E-02	0.00E+00	1.2281E+00	1.1107E+02
α_3	4.03E-06	3.60E-03	1.33E-03	1.49E-02	0.00E+00	4.0431E-01	1.1189E+02
α_4	8.52E-09	1.98E-03	2.70E-04	9.93E-03	0.00E+00	2.2267E-01	1.1207E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9571140	0.9784250	0.9803390	0.9931890	1.0000000	1.6046E+02	3.5382E+00
α_2	2.47E-03	1.29E-02	1.10E-02	2.99E-02	0.00E+00	2.1142E+00	1.6188E+02
α_3	2.90E-04	5.96E-03	4.11E-03	1.79E-02	0.00E+00	9.7738E-01	1.6302E+02
α_4	1.50E-06	2.28E-03	7.68E-04	9.70E-03	0.00E+00	3.7439E-01	1.6362E+02
α_5	3.63E-21	4.41E-04	2.49E-07	2.55E-03	0.00E+00	7.2277E-02	1.6393E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9564150	0.9769370	0.9786330	0.9916720	1.0000000	1.8124E+02	4.2787E+00
α_2	2.47E-03	1.21E-02	1.04E-02	2.75E-02	0.00E+00	2.2392E+00	1.8328E+02
α_3	4.32E-04	6.15E-03	4.50E-03	1.75E-02	0.00E+00	1.1418E+00	1.8438E+02
α_4	2.85E-05	3.19E-03	1.67E-03	1.15E-02	0.00E+00	5.9222E-01	1.8493E+02
α_5	5.00E-09	1.20E-03	1.62E-04	6.00E-03	0.00E+00	2.2220E-01	1.8530E+02
α_6	7.59E-19	4.49E-04	7.84E-07	2.62E-03	0.00E+00	8.3237E-02	1.8544E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9567180	0.9747050	0.9759400	0.9884830	1.0000000	2.4835E+02	6.4450E+00
α_2	3.41E-03	1.21E-02	1.09E-02	2.51E-02	0.00E+00	3.0878E+00	2.5171E+02
α_3	8.62E-04	6.40E-03	5.17E-03	1.62E-02	0.00E+00	1.6312E+00	2.5316E+02
α_4	1.94E-04	3.88E-03	2.69E-03	1.17E-02	0.00E+00	9.8887E-01	2.5381E+02
α_5	1.01E-05	2.05E-03	9.69E-04	7.74E-03	0.00E+00	5.2177E-01	2.5427E+02
α_6	2.64E-10	7.31E-04	6.24E-05	3.84E-03	0.00E+00	1.8628E-01	2.5461E+02
α_7	0.00E+00	1.14E-04	9.98E-14	4.29E-04	0.00E+00	2.9071E-02	2.5477E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9574500	0.9743160	0.9754000	0.9874930	1.0000000	2.8303E+02	7.4610E+00
α_2	3.46E-03	1.15E-02	1.04E-02	2.33E-02	0.00E+00	3.3447E+00	2.8715E+02
α_3	8.85E-04	5.98E-03	4.90E-03	1.48E-02	0.00E+00	1.7384E+00	2.8875E+02
α_4	2.79E-04	3.95E-03	2.88E-03	1.12E-02	0.00E+00	1.1465E+00	2.8934E+02
α_5	4.44E-05	2.44E-03	1.43E-03	8.25E-03	0.00E+00	7.0833E-01	2.8978E+02
α_6	7.15E-07	1.26E-03	4.13E-04	5.40E-03	0.00E+00	3.6696E-01	2.9012E+02
α_7	5.60E-14	4.23E-04	7.61E-06	2.41E-03	0.00E+00	1.2297E-01	2.9037E+02
α_8	1.05E-42	1.14E-04	1.62E-12	4.82E-04	0.00E+00	3.3124E-02	2.9046E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	64.30	64.30	64.30	64.30	64.30	64.30	64.30
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.15.2.3 ACP 4160 AND 6.9 CIRCUIT BREAKERS SPURIOUS OP SPAR: CRB-CO

System :	Plant ac power
Component :	Circuit Breaker
Failure Mode :	Spurious operation open or close
Component Group :	4160 - 6900 Volt
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 38.50
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8913050	0.9710630	0.9860450	0.9998670	0.9889070	1.7199E+01	5.1252E-01
α_2	1.35E-04	2.89E-02	1.40E-02	1.09E-01	1.11E-02	5.1252E-01	1.7199E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9133790	0.9675140	0.9747700	0.9968110	0.9775840	3.9751E+01	1.3347E+00
α_2	1.60E-03	2.60E-02	1.88E-02	7.51E-02	2.24E-02	1.0673E+00	4.0018E+01
α_3	2.30E-07	6.51E-03	1.32E-03	3.09E-02	1.92E-05	2.6742E-01	4.0818E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9161920	0.9623880	0.9672760	0.9918450	0.9660280	5.9410E+01	2.3219E+00
α_2	3.97E-03	2.74E-02	2.25E-02	6.78E-02	3.39E-02	1.6943E+00	6.0038E+01
α_3	7.46E-06	6.56E-03	2.44E-03	2.71E-02	4.37E-05	4.0491E-01	6.1327E+01
α_4	1.56E-08	3.61E-03	4.94E-04	1.81E-02	0.00E+00	2.2267E-01	6.1509E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9305980	0.9630170	0.9656380	0.9864800	0.9542460	1.1237E+02	4.3153E+00
α_2	6.62E-03	2.48E-02	2.21E-02	5.20E-02	4.57E-02	2.8899E+00	1.1380E+02
α_3	4.11E-04	8.39E-03	5.80E-03	2.52E-02	8.24E-05	9.7878E-01	1.1571E+02
α_4	2.11E-06	3.21E-03	1.08E-03	1.36E-02	0.00E+00	3.7439E-01	1.1631E+02
α_5	5.11E-21	6.19E-04	3.50E-07	3.59E-03	0.00E+00	7.2277E-02	1.1661E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9317790	0.9614990	0.9636620	0.9838410	0.9422200	1.3593E+02	5.4430E+00
α_2	7.37E-03	2.41E-02	2.18E-02	4.83E-02	5.76E-02	3.4008E+00	1.3797E+02
α_3	5.72E-04	8.09E-03	5.92E-03	2.30E-02	1.29E-04	1.1444E+00	1.4023E+02
α_4	3.75E-05	4.19E-03	2.19E-03	1.51E-02	4.96E-06	5.9232E-01	1.4078E+02
α_5	6.57E-09	1.57E-03	2.13E-04	7.87E-03	0.00E+00	2.2220E-01	1.4115E+02
α_6	9.97E-19	5.89E-04	1.03E-06	3.44E-03	0.00E+00	8.3237E-02	1.4129E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9410550	0.9641110	0.9655530	0.9822530	0.9473050	2.0613E+02	7.6731E+00
α_2	6.75E-03	1.92E-02	1.78E-02	3.68E-02	4.39E-02	4.1114E+00	2.0969E+02
α_3	1.37E-03	8.59E-03	7.11E-03	2.08E-02	8.77E-03	1.8355E+00	2.1197E+02
α_4	2.32E-04	4.63E-03	3.20E-03	1.39E-02	8.58E-06	9.8907E-01	2.1281E+02
α_5	1.20E-05	2.44E-03	1.16E-03	9.22E-03	0.00E+00	5.2177E-01	2.1328E+02
α_6	3.14E-10	8.71E-04	7.44E-05	4.57E-03	0.00E+00	1.8628E-01	2.1362E+02
α_7	0.00E+00	1.36E-04	1.19E-13	5.12E-04	0.00E+00	2.9071E-02	2.1377E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9445560	0.9653150	0.9665340	0.9819060	0.9507800	2.4388E+02	8.7629E+00
α_2	6.10E-03	1.69E-02	1.57E-02	3.21E-02	3.53E-02	4.2796E+00	2.4836E+02
α_3	1.52E-03	8.17E-03	6.92E-03	1.91E-02	1.23E-02	2.0650E+00	2.5058E+02
α_4	3.58E-04	4.70E-03	3.47E-03	1.32E-02	1.53E-03	1.1869E+00	2.5146E+02
α_5	5.10E-05	2.80E-03	1.65E-03	9.49E-03	0.00E+00	7.0833E-01	2.5193E+02
α_6	8.22E-07	1.45E-03	4.75E-04	6.21E-03	0.00E+00	3.6696E-01	2.5228E+02
α_7	6.44E-14	4.87E-04	8.75E-06	2.77E-03	0.00E+00	1.2297E-01	2.5252E+02
α_8	1.21E-42	1.31E-04	1.87E-12	5.54E-04	0.00E+00	3.3124E-02	2.5261E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9889070	0.9775840	0.9660280	0.9542460	0.9422200	0.9473050	0.9507800
α_2	1.11E-02	2.24E-02	3.39E-02	4.57E-02	5.76E-02	4.39E-02	3.53E-02
α_3		1.92E-05	4.37E-05	8.24E-05	1.29E-04	8.77E-03	1.23E-02
α_4			0.00E+00	0.00E+00	4.96E-06	8.58E-06	1.53E-03
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.89E-01	9.78E-01	9.66E-01	9.54E-01	9.42E-01	9.47E-01	9.51E-01
Beta	1.11E-02	2.24E-02	3.40E-02	4.58E-02	5.78E-02	5.27E-02	4.92E-02
Gamma		8.55E-04	1.29E-03	1.80E-03	2.32E-03	1.67E-01	2.82E-01
Delta			0.00E+00	0.00E+00	3.70E-02	9.78E-04	1.10E-01
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	6.08	9.12	12.15	15.19	18.23	21.27	24.31
N_1	0.8732	1.0762	1.1241	1.0173	0.7561	0.8076	0.8387
N_2	0.0780	0.2336	0.4662	0.7757	1.1616	1.0236	0.9349
N_3		0.0002	0.0006	0.0014	0.0026	0.2043	0.3266
N_4			0.0000	0.0000	0.0001	0.0002	0.0404
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.16 DC Power System - Batteries, Chargers, and Breakers

1.16.1 Batteries

1.16.1.1 DC POWER BATTERY NO OUTPUT SPAR:BAT-LP

System :	dc power
Component :	Battery
Failure Mode :	
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 59.20
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9749560	0.9937820	0.9975050	0.9999880	1.0000000	6.9446E+01	4.3452E-01
α_2	1.11E-05	6.22E-03	2.49E-03	2.50E-02	0.00E+00	4.3452E-01	6.9446E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9647310	0.9877480	0.9911340	0.9991990	1.0000000	8.8755E+01	1.1009E+00
α_2	2.91E-04	9.28E-03	5.98E-03	2.95E-02	0.00E+00	8.3366E-01	8.9022E+01
α_3	1.04E-07	2.97E-03	5.96E-04	1.41E-02	0.00E+00	2.6722E-01	8.9589E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9582810	0.9826940	0.9855990	0.9971810	1.0000000	1.0534E+02	1.8551E+00
α_2	9.42E-04	1.15E-02	8.59E-03	3.18E-02	0.00E+00	1.2281E+00	1.0597E+02
α_3	4.23E-06	3.77E-03	1.39E-03	1.56E-02	0.00E+00	4.0431E-01	1.0679E+02
α_4	8.93E-09	2.08E-03	2.83E-04	1.04E-02	0.00E+00	2.2267E-01	1.0697E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9557490	0.9777330	0.9797050	0.9929730	1.0000000	1.5536E+02	3.5382E+00
α_2	2.55E-03	1.33E-02	1.13E-02	3.08E-02	0.00E+00	2.1142E+00	1.5678E+02
α_3	3.00E-04	6.15E-03	4.24E-03	1.85E-02	0.00E+00	9.7738E-01	1.5792E+02
α_4	1.55E-06	2.36E-03	7.92E-04	1.00E-02	0.00E+00	3.7439E-01	1.5852E+02
α_5	3.75E-21	4.55E-04	2.57E-07	2.63E-03	0.00E+00	7.2277E-02	1.5883E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9551940	0.9762850	0.9780270	0.9914340	1.0000000	1.7614E+02	4.2787E+00
α_2	2.54E-03	1.24E-02	1.07E-02	2.83E-02	0.00E+00	2.2392E+00	1.7818E+02
α_3	4.45E-04	6.33E-03	4.62E-03	1.80E-02	0.00E+00	1.1418E+00	1.7928E+02
α_4	2.93E-05	3.28E-03	1.72E-03	1.18E-02	0.00E+00	5.9222E-01	1.7983E+02
α_5	5.14E-09	1.23E-03	1.67E-04	6.17E-03	0.00E+00	2.2220E-01	1.8020E+02
α_6	7.81E-19	4.61E-04	8.06E-07	2.69E-03	0.00E+00	8.3237E-02	1.8034E+02

DC POWER BATTERY NO OUTPUT SPAR:BAT-LP

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9558400	0.9741890	0.9754470	0.9882450	1.0000000	2.4325E+02	6.4450E+00
α_2	3.48E-03	1.24E-02	1.11E-02	2.56E-02	0.00E+00	3.0878E+00	2.4661E+02
α_3	8.79E-04	6.53E-03	5.27E-03	1.65E-02	0.00E+00	1.6312E+00	2.4806E+02
α_4	1.98E-04	3.96E-03	2.74E-03	1.19E-02	0.00E+00	9.8887E-01	2.4871E+02
α_5	1.03E-05	2.09E-03	9.89E-04	7.90E-03	0.00E+00	5.2177E-01	2.4917E+02
α_6	2.69E-10	7.46E-04	6.37E-05	3.92E-03	0.00E+00	1.8628E-01	2.4951E+02
α_7	0.00E+00	1.16E-04	1.02E-13	4.38E-04	0.00E+00	2.9071E-02	2.4967E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9566950	0.9738570	0.9749590	0.9872680	1.0000000	2.7793E+02	7.4610E+00
α_2	3.52E-03	1.17E-02	1.06E-02	2.37E-02	0.00E+00	3.3447E+00	2.8205E+02
α_3	9.00E-04	6.09E-03	4.98E-03	1.51E-02	0.00E+00	1.7384E+00	2.8365E+02
α_4	2.84E-04	4.02E-03	2.93E-03	1.14E-02	0.00E+00	1.1465E+00	2.8424E+02
α_5	4.52E-05	2.48E-03	1.46E-03	8.40E-03	0.00E+00	7.0833E-01	2.8468E+02
α_6	7.27E-07	1.29E-03	4.21E-04	5.50E-03	0.00E+00	3.6696E-01	2.8502E+02
α_7	5.70E-14	4.31E-04	7.75E-06	2.45E-03	0.00E+00	1.2297E-01	2.8527E+02
α_8	1.07E-42	1.16E-04	1.65E-12	4.90E-04	0.00E+00	3.3124E-02	2.8536E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	59.20	59.20	59.20	59.20	59.20	59.20	59.20
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.16.2 Battery Chargers

1.16.2.1 DC POWER BATTERY CHARGER LOSS OF FUNCTION SPAR: BCH-FC

System : dc power
Component : Battery Charger
Failure Mode :

Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 0.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8386830	0.9593170	0.9828300	0.9999250	1.0000000	1.0246E+01	4.3452E-01
α_2	7.70E-05	4.07E-02	1.72E-02	1.61E-01	0.00E+00	4.3452E-01	1.0246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8979020	0.9640890	0.9736330	0.9976040	1.0000000	2.9555E+01	1.1009E+00
α_2	8.71E-04	2.72E-02	1.78E-02	8.57E-02	0.00E+00	8.3366E-01	2.9822E+01
α_3	3.08E-07	8.72E-03	1.77E-03	4.13E-02	0.00E+00	2.6722E-01	3.0389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9077330	0.9613450	0.9675780	0.9936050	1.0000000	4.6136E+01	1.8551E+00
α_2	2.13E-03	2.56E-02	1.93E-02	7.04E-02	0.00E+00	1.2281E+00	4.6763E+01
α_3	9.52E-06	8.42E-03	3.13E-03	3.48E-02	0.00E+00	4.0431E-01	4.7587E+01
α_4	2.01E-08	4.64E-03	6.37E-04	2.32E-02	0.00E+00	2.2267E-01	4.7768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9298110	0.9645110	0.9675740	0.9887220	1.0000000	9.6161E+01	3.5382E+00
α_2	4.09E-03	2.12E-02	1.81E-02	4.90E-02	0.00E+00	2.1142E+00	9.7585E+01
α_3	4.79E-04	9.80E-03	6.78E-03	2.95E-02	0.00E+00	9.7738E-01	9.8722E+01
α_4	2.47E-06	3.76E-03	1.27E-03	1.59E-02	0.00E+00	3.7439E-01	9.9325E+01
α_5	5.99E-21	7.25E-04	4.10E-07	4.20E-03	0.00E+00	7.2277E-02	9.9627E+01

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9335790	0.9647030	0.9672350	0.9871780	1.0000000	1.1694E+02	4.2787E+00
α_2	3.80E-03	1.85E-02	1.59E-02	4.20E-02	0.00E+00	2.2392E+00	1.1898E+02
α_3	6.64E-04	9.42E-03	6.89E-03	2.68E-02	0.00E+00	1.1418E+00	1.2008E+02
α_4	4.37E-05	4.89E-03	2.56E-03	1.76E-02	0.00E+00	5.9222E-01	1.2063E+02
α_5	7.67E-09	1.83E-03	2.49E-04	9.18E-03	0.00E+00	2.2220E-01	1.2100E+02
α_6	1.16E-18	6.87E-04	1.20E-06	4.01E-03	0.00E+00	8.3237E-02	1.2114E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9422570	0.9661670	0.9677850	0.9845420	1.0000000	1.8405E+02	6.4450E+00
α_2	4.57E-03	1.62E-02	1.45E-02	3.35E-02	0.00E+00	3.0878E+00	1.8741E+02
α_3	1.15E-03	8.56E-03	6.91E-03	2.16E-02	0.00E+00	1.6312E+00	1.8886E+02
α_4	2.60E-04	5.19E-03	3.59E-03	1.56E-02	0.00E+00	9.8887E-01	1.8951E+02
α_5	1.35E-05	2.74E-03	1.30E-03	1.04E-02	0.00E+00	5.2177E-01	1.8997E+02
α_6	3.53E-10	9.78E-04	8.35E-05	5.13E-03	0.00E+00	1.8628E-01	1.9031E+02
α_7	0.00E+00	1.53E-04	1.34E-13	5.75E-04	0.00E+00	2.9071E-02	1.9047E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9454620	0.9670150	0.9683850	0.9838980	1.0000000	2.1873E+02	7.4610E+00
α_2	4.45E-03	1.48E-02	1.34E-02	2.99E-02	0.00E+00	3.3447E+00	2.2285E+02
α_3	1.14E-03	7.69E-03	6.29E-03	1.90E-02	0.00E+00	1.7384E+00	2.2445E+02
α_4	3.59E-04	5.07E-03	3.71E-03	1.44E-02	0.00E+00	1.1465E+00	2.2504E+02
α_5	5.70E-05	3.13E-03	1.84E-03	1.06E-02	0.00E+00	7.0833E-01	2.2548E+02
α_6	9.18E-07	1.62E-03	5.31E-04	6.94E-03	0.00E+00	3.6696E-01	2.2582E+02
α_7	7.20E-14	5.44E-04	9.78E-06	3.10E-03	0.00E+00	1.2297E-01	2.2607E+02
α_8	1.35E-42	1.46E-04	2.09E-12	6.19E-04	0.00E+00	3.3124E-02	2.2616E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.16.2.2 DC POWER BATTERY CHARGER NO OUTPUT SPAR:BCH-LP

System : dc power
Component : Battery Charger
Failure Mode :
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 281.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9939980	0.9985130	0.9994140	0.9999940	1.0000000	2.9175E+02	4.3452E-01
α_2	2.63E-06	1.49E-03	5.92E-04	6.00E-03	0.00E+00	4.3452E-01	2.9175E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9898020	0.9964730	0.9974580	0.9997700	1.0000000	3.1105E+02	1.1009E+00
α_2	8.33E-05	2.67E-03	1.71E-03	8.52E-03	0.00E+00	8.3366E-01	3.1132E+02
α_3	2.96E-08	8.56E-04	1.71E-04	4.06E-03	0.00E+00	2.6722E-01	3.1188E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9863540	0.9943700	0.9953320	0.9990880	1.0000000	3.2764E+02	1.8551E+00
α_2	3.04E-04	3.73E-03	2.78E-03	1.04E-02	0.00E+00	1.2281E+00	3.2827E+02
α_3	1.37E-06	1.23E-03	4.51E-04	5.08E-03	0.00E+00	4.0431E-01	3.2909E+02
α_4	2.89E-09	6.76E-04	9.18E-05	3.38E-03	0.00E+00	2.2267E-01	3.2927E+02

DC POWER BATTERY CHARGER NO OUTPUT SPAR:BCH-LP

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9814670	0.9907180	0.9915640	0.9970910	1.0000000	3.7766E+02	3.5382E+00
α_2	1.06E-03	5.55E-03	4.71E-03	1.29E-02	0.00E+00	2.1142E+00	3.7908E+02
α_3	1.24E-04	2.56E-03	1.76E-03	7.73E-03	0.00E+00	9.7738E-01	3.8022E+02
α_4	6.43E-07	9.82E-04	3.29E-04	4.17E-03	0.00E+00	3.7439E-01	3.8082E+02
α_5	1.56E-21	1.90E-04	1.07E-07	1.10E-03	0.00E+00	7.2277E-02	3.8113E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9798370	0.9893760	0.9901720	0.9961810	1.0000000	3.9844E+02	4.2787E+00
α_2	1.13E-03	5.56E-03	4.77E-03	1.27E-02	0.00E+00	2.2392E+00	4.0048E+02
α_3	1.99E-04	2.84E-03	2.07E-03	8.10E-03	0.00E+00	1.1418E+00	4.0158E+02
α_4	1.31E-05	1.47E-03	7.68E-04	5.31E-03	0.00E+00	5.9222E-01	4.0213E+02
α_5	2.30E-09	5.52E-04	7.46E-05	2.76E-03	0.00E+00	2.2220E-01	4.0250E+02
α_6	3.49E-19	2.07E-04	3.61E-07	1.20E-03	0.00E+00	8.3237E-02	4.0264E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9765600	0.9863450	0.9870240	0.9938090	1.0000000	4.6555E+02	6.4450E+00
α_2	1.83E-03	6.54E-03	5.86E-03	1.36E-02	0.00E+00	3.0878E+00	4.6891E+02
α_3	4.64E-04	3.46E-03	2.78E-03	8.74E-03	0.00E+00	1.6312E+00	4.7036E+02
α_4	1.05E-04	2.10E-03	1.45E-03	6.29E-03	0.00E+00	9.8887E-01	4.7101E+02
α_5	5.42E-06	1.11E-03	5.22E-04	4.18E-03	0.00E+00	5.2177E-01	4.7147E+02
α_6	1.42E-10	3.95E-04	3.36E-05	2.07E-03	0.00E+00	1.8628E-01	4.7181E+02
α_7	0.00E+00	6.16E-05	5.38E-14	2.32E-04	0.00E+00	2.9071E-02	4.7197E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9755780	0.9853040	0.9859340	0.9928700	1.0000000	5.0023E+02	7.4610E+00
α_2	1.97E-03	6.59E-03	5.95E-03	1.34E-02	0.00E+00	3.3447E+00	5.0435E+02
α_3	5.05E-04	3.42E-03	2.80E-03	8.48E-03	0.00E+00	1.7384E+00	5.0595E+02
α_4	1.60E-04	2.26E-03	1.65E-03	6.44E-03	0.00E+00	1.1465E+00	5.0654E+02
α_5	2.53E-05	1.40E-03	8.19E-04	4.73E-03	0.00E+00	7.0833E-01	5.0698E+02
α_6	4.08E-07	7.23E-04	2.36E-04	3.09E-03	0.00E+00	3.6696E-01	5.0732E+02
α_7	3.20E-14	2.42E-04	4.35E-06	1.38E-03	0.00E+00	1.2297E-01	5.0757E+02
α_8	6.00E-43	6.52E-05	9.29E-13	2.75E-04	0.00E+00	3.3124E-02	5.0766E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	281.50	281.50	281.50	281.50	281.50	281.50	281.50
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.16.3 DC Power Distribution Circuit Breakers

1.16.3.1 DC POWER BREAKER FAIL TO OPEN

System :	dc power
Component :	Circuit Breaker
Failure Mode :	Fail to open on demand
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 1.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8581890	0.9643270	0.9850590	0.9999350	1.0000000	1.1746E+01	4.3452E-01
α_2	6.69E-05	3.57E-02	1.49E-02	1.42E-01	0.00E+00	4.3452E-01	1.1746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9025780	0.9657640	0.9748880	0.9977200	1.0000000	3.1055E+01	1.1009E+00
α_2	8.29E-04	2.59E-02	1.69E-02	8.18E-02	0.00E+00	8.3366E-01	3.1322E+01
α_3	2.93E-07	8.31E-03	1.69E-03	3.94E-02	0.00E+00	2.6722E-01	3.1889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9104790	0.9625170	0.9685780	0.9938040	1.0000000	4.7636E+01	1.8551E+00
α_2	2.06E-03	2.48E-02	1.87E-02	6.83E-02	0.00E+00	1.2281E+00	4.8263E+01
α_3	9.23E-06	8.17E-03	3.04E-03	3.37E-02	0.00E+00	4.0431E-01	4.9087E+01
α_4	1.95E-08	4.50E-03	6.18E-04	2.25E-02	0.00E+00	2.2267E-01	4.9268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9308380	0.9650370	0.9680620	0.9888920	1.0000000	9.7661E+01	3.5382E+00
α_2	4.03E-03	2.09E-02	1.78E-02	4.83E-02	0.00E+00	2.1142E+00	9.9085E+01
α_3	4.72E-04	9.66E-03	6.68E-03	2.90E-02	0.00E+00	9.7738E-01	1.0022E+02
α_4	2.43E-06	3.70E-03	1.25E-03	1.57E-02	0.00E+00	3.7439E-01	1.0082E+02
α_5	5.90E-21	7.14E-04	4.04E-07	4.14E-03	0.00E+00	7.2277E-02	1.0113E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9343810	0.9651340	0.9676320	0.9873370	1.0000000	1.1844E+02	4.2787E+00
α_2	3.75E-03	1.82E-02	1.57E-02	4.15E-02	0.00E+00	2.2392E+00	1.2048E+02
α_3	6.56E-04	9.30E-03	6.81E-03	2.65E-02	0.00E+00	1.1418E+00	1.2158E+02
α_4	4.32E-05	4.83E-03	2.53E-03	1.74E-02	0.00E+00	5.9222E-01	1.2213E+02
α_5	7.57E-09	1.81E-03	2.46E-04	9.07E-03	0.00E+00	2.2220E-01	1.2250E+02
α_6	1.15E-18	6.78E-04	1.19E-06	3.96E-03	0.00E+00	8.3237E-02	1.2264E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9426990	0.9664310	0.9680420	0.9846650	1.0000000	1.8555E+02	6.4450E+00
α_2	4.53E-03	1.61E-02	1.44E-02	3.33E-02	0.00E+00	3.0878E+00	1.8891E+02
α_3	1.15E-03	8.50E-03	6.86E-03	2.14E-02	0.00E+00	1.6312E+00	1.9036E+02
α_4	2.58E-04	5.15E-03	3.57E-03	1.55E-02	0.00E+00	9.8887E-01	1.9101E+02
α_5	1.34E-05	2.72E-03	1.29E-03	1.03E-02	0.00E+00	5.2177E-01	1.9147E+02
α_6	3.50E-10	9.70E-04	8.29E-05	5.09E-03	0.00E+00	1.8628E-01	1.9181E+02
α_7	0.00E+00	1.51E-04	1.33E-13	5.70E-04	0.00E+00	2.9071E-02	1.9197E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9458180	0.9672320	0.9685940	0.9840060	1.0000000	2.2023E+02	7.4610E+00
α_2	4.42E-03	1.47E-02	1.33E-02	2.97E-02	0.00E+00	3.3447E+00	2.2435E+02
α_3	1.13E-03	7.63E-03	6.25E-03	1.89E-02	0.00E+00	1.7384E+00	2.2595E+02
α_4	3.57E-04	5.04E-03	3.68E-03	1.43E-02	0.00E+00	1.1465E+00	2.2654E+02
α_5	5.66E-05	3.11E-03	1.83E-03	1.05E-02	0.00E+00	7.0833E-01	2.2698E+02
α_6	9.12E-07	1.61E-03	5.28E-04	6.89E-03	0.00E+00	3.6696E-01	2.2732E+02
α_7	7.15E-14	5.40E-04	9.71E-06	3.07E-03	0.00E+00	1.2297E-01	2.2757E+02
α_8	1.34E-42	1.45E-04	2.07E-12	6.15E-04	0.00E+00	3.3124E-02	2.2766E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	1.50	1.50	1.50	1.50	1.50	1.50	1.50
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.16.3.2 DC POWER BREAKER FAIL TO CLOSE

System : dc power
Component : Circuit Breaker
Failure Mode : Fail to close (reseat) on demand
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 11.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9197400	0.9799580	0.9917970	0.9999600	1.0000000	2.1246E+01	4.3452E-01
α_2	3.66E-05	2.00E-02	8.20E-03	8.03E-02	0.00E+00	4.3452E-01	2.1246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9244850	0.9735720	0.9807070	0.9982570	1.0000000	4.0555E+01	1.1009E+00
α_2	6.36E-04	2.00E-02	1.30E-02	6.33E-02	0.00E+00	8.3366E-01	4.0822E+01
α_3	2.25E-07	6.41E-03	1.30E-03	3.04E-02	0.00E+00	2.6722E-01	4.1389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9246840	0.9685530	0.9736960	0.9948200	1.0000000	5.7136E+01	1.8551E+00
α_2	1.73E-03	2.08E-02	1.57E-02	5.74E-02	0.00E+00	1.2281E+00	5.7763E+01
α_3	7.72E-06	6.85E-03	2.54E-03	2.83E-02	0.00E+00	4.0431E-01	5.8587E+01
α_4	1.63E-08	3.77E-03	5.17E-04	1.89E-02	0.00E+00	2.2267E-01	5.8768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9367020	0.9680370	0.9708150	0.9898600	1.0000000	1.0716E+02	3.5382E+00
α_2	3.68E-03	1.91E-02	1.63E-02	4.41E-02	0.00E+00	2.1142E+00	1.0858E+02
α_3	4.31E-04	8.83E-03	6.10E-03	2.65E-02	0.00E+00	9.7738E-01	1.0972E+02
α_4	2.22E-06	3.38E-03	1.14E-03	1.44E-02	0.00E+00	3.7439E-01	1.1032E+02
α_5	5.39E-21	6.53E-04	3.69E-07	3.78E-03	0.00E+00	7.2277E-02	1.1063E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9390430	0.9676400	0.9699700	0.9882600	1.0000000	1.2794E+02	4.2787E+00
α_2	3.48E-03	1.69E-02	1.46E-02	3.85E-02	0.00E+00	2.2392E+00	1.2998E+02
α_3	6.08E-04	8.64E-03	6.32E-03	2.46E-02	0.00E+00	1.1418E+00	1.3108E+02
α_4	4.01E-05	4.48E-03	2.35E-03	1.62E-02	0.00E+00	5.9222E-01	1.3163E+02
α_5	7.03E-09	1.68E-03	2.28E-04	8.42E-03	0.00E+00	2.2220E-01	1.3200E+02
α_6	1.07E-18	6.30E-04	1.10E-06	3.67E-03	0.00E+00	8.3237E-02	1.3214E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9453790	0.9680140	0.9695500	0.9853960	1.0000000	1.9505E+02	6.4450E+00
α_2	4.32E-03	1.53E-02	1.38E-02	3.17E-02	0.00E+00	3.0878E+00	1.9841E+02
α_3	1.09E-03	8.10E-03	6.54E-03	2.04E-02	0.00E+00	1.6312E+00	1.9986E+02
α_4	2.46E-04	4.91E-03	3.40E-03	1.47E-02	0.00E+00	9.8887E-01	2.0051E+02
α_5	1.27E-05	2.59E-03	1.23E-03	9.79E-03	0.00E+00	5.2177E-01	2.0097E+02
α_6	3.34E-10	9.24E-04	7.89E-05	4.85E-03	0.00E+00	1.8628E-01	2.0131E+02
α_7	0.00E+00	1.44E-04	1.26E-13	5.43E-04	0.00E+00	2.9071E-02	2.0147E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9479690	0.9685440	0.9698520	0.9846520	1.0000000	2.2973E+02	7.4610E+00
α_2	4.24E-03	1.41E-02	1.28E-02	2.85E-02	0.00E+00	3.3447E+00	2.3385E+02
α_3	1.08E-03	7.33E-03	6.00E-03	1.81E-02	0.00E+00	1.7384E+00	2.3545E+02
α_4	3.42E-04	4.83E-03	3.53E-03	1.38E-02	0.00E+00	1.1465E+00	2.3604E+02
α_5	5.44E-05	2.99E-03	1.76E-03	1.01E-02	0.00E+00	7.0833E-01	2.3648E+02
α_6	8.76E-07	1.55E-03	5.07E-04	6.62E-03	0.00E+00	3.6696E-01	2.3682E+02
α_7	6.87E-14	5.18E-04	9.32E-06	2.95E-03	0.00E+00	1.2297E-01	2.3707E+02
α_8	1.29E-42	1.40E-04	1.99E-12	5.90E-04	0.00E+00	3.3124E-02	2.3716E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	11.00	11.00	11.00	11.00	11.00	11.00	11.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.16.3.3 DC POWER BREAKER SPURIOUS ACTUATION

System : dc power
Component : Circuit Breaker
Failure Mode : Spurious operation open or close
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 14.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9308130	0.9827440	0.9929710	0.9999660	1.0000000	2.4746E+01	4.3452E-01
α_2	3.14E-05	1.73E-02	7.03E-03	6.92E-02	0.00E+00	4.3452E-01	2.4746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9302590	0.9756200	0.9822250	0.9983900	1.0000000	4.4055E+01	1.1009E+00
α_2	5.86E-04	1.85E-02	1.20E-02	5.85E-02	0.00E+00	8.3366E-01	4.4322E+01
α_3	2.07E-07	5.92E-03	1.19E-03	2.81E-02	0.00E+00	2.6722E-01	4.4889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9288470	0.9703150	0.9751850	0.9951160	1.0000000	6.0636E+01	1.8551E+00
α_2	1.63E-03	1.97E-02	1.48E-02	5.43E-02	0.00E+00	1.2281E+00	6.1263E+01
α_3	7.29E-06	6.47E-03	2.40E-03	2.67E-02	0.00E+00	4.0431E-01	6.2087E+01
α_4	1.54E-08	3.56E-03	4.88E-04	1.78E-02	0.00E+00	2.2267E-01	6.2268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9386190	0.9690170	0.9717140	0.9901760	1.0000000	1.1066E+02	3.5382E+00
α_2	3.56E-03	1.85E-02	1.58E-02	4.28E-02	0.00E+00	2.1142E+00	1.1208E+02
α_3	4.18E-04	8.56E-03	5.91E-03	2.57E-02	0.00E+00	9.7738E-01	1.1322E+02
α_4	2.15E-06	3.28E-03	1.10E-03	1.39E-02	0.00E+00	3.7439E-01	1.1382E+02
α_5	5.22E-21	6.33E-04	3.58E-07	3.66E-03	0.00E+00	7.2277E-02	1.1413E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9405980	0.9684740	0.9707480	0.9885670	1.0000000	1.3144E+02	4.2787E+00
α_2	3.39E-03	1.65E-02	1.42E-02	3.75E-02	0.00E+00	2.2392E+00	1.3348E+02
α_3	5.92E-04	8.41E-03	6.15E-03	2.40E-02	0.00E+00	1.1418E+00	1.3458E+02
α_4	3.90E-05	4.36E-03	2.29E-03	1.57E-02	0.00E+00	5.9222E-01	1.3513E+02
α_5	6.84E-09	1.64E-03	2.22E-04	8.20E-03	0.00E+00	2.2220E-01	1.3550E+02
α_6	1.04E-18	6.13E-04	1.07E-06	3.58E-03	0.00E+00	8.3237E-02	1.3564E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9463040	0.9685600	0.9700710	0.9856530	1.0000000	1.9855E+02	6.4450E+00
α_2	4.24E-03	1.51E-02	1.35E-02	3.12E-02	0.00E+00	3.0878E+00	2.0191E+02
α_3	1.07E-03	7.96E-03	6.42E-03	2.01E-02	0.00E+00	1.6312E+00	2.0336E+02
α_4	2.42E-04	4.82E-03	3.34E-03	1.45E-02	0.00E+00	9.8887E-01	2.0401E+02
α_5	1.25E-05	2.55E-03	1.21E-03	9.62E-03	0.00E+00	5.2177E-01	2.0447E+02
α_6	3.28E-10	9.09E-04	7.76E-05	4.77E-03	0.00E+00	1.8628E-01	2.0481E+02
α_7	0.00E+00	1.42E-04	1.24E-13	5.34E-04	0.00E+00	2.9071E-02	2.0497E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9487150	0.9690020	0.9702910	0.9848780	1.0000000	2.3323E+02	7.4610E+00
α_2	4.18E-03	1.39E-02	1.26E-02	2.81E-02	0.00E+00	3.3447E+00	2.3735E+02
α_3	1.07E-03	7.22E-03	5.91E-03	1.79E-02	0.00E+00	1.7384E+00	2.3895E+02
α_4	3.37E-04	4.76E-03	3.48E-03	1.36E-02	0.00E+00	1.1465E+00	2.3954E+02
α_5	5.36E-05	2.94E-03	1.73E-03	9.96E-03	0.00E+00	7.0833E-01	2.3998E+02
α_6	8.63E-07	1.52E-03	4.99E-04	6.52E-03	0.00E+00	3.6696E-01	2.4032E+02
α_7	6.77E-14	5.11E-04	9.19E-06	2.91E-03	0.00E+00	1.2297E-01	2.4057E+02
α_8	1.27E-42	1.38E-04	1.96E-12	5.82E-04	0.00E+00	3.3124E-02	2.4066E+02

ALPHA FACTOR and MGL PARAMETERS

DC POWER BREAKER SPURIOUS ACTUATION

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	14.50	14.50	14.50	14.50	14.50	14.50	14.50
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.17 Reactor Protection System, Reactor Trip Breakers

1.17.1 Reactor Trip Breakers

1.17.1.1 REACTOR TRIP BREAKERS FAIL TO OPEN

System :	Reactor protection
Component :	Circuit Breaker
Failure Mode :	Fail to open on demand
Component Group :	Reactor Trip Breaker
Start Date :	1997/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 7.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9017830	0.9754240	0.9898730	0.9999510	1.0000000	1.7246E+01	4.3452E-01
α_2	4.52E-05	2.46E-02	1.01E-02	9.82E-02	0.00E+00	4.3452E-01	1.7246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9165860	0.9707650	0.9786210	0.9980670	1.0000000	3.6555E+01	1.1009E+00
α_2	7.05E-04	2.21E-02	1.44E-02	7.00E-02	0.00E+00	8.3366E-01	3.6822E+01
α_3	2.49E-07	7.10E-03	1.44E-03	3.37E-02	0.00E+00	2.6722E-01	3.7389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9192920	0.9662660	0.9717540	0.9944390	1.0000000	5.3136E+01	1.8551E+00
α_2	1.85E-03	2.23E-02	1.68E-02	6.16E-02	0.00E+00	1.2281E+00	5.3763E+01
α_3	8.29E-06	7.35E-03	2.73E-03	3.04E-02	0.00E+00	4.0431E-01	5.4587E+01
α_4	1.75E-08	4.05E-03	5.55E-04	2.03E-02	0.00E+00	2.2267E-01	5.4768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9343580	0.9668390	0.9697150	0.9894740	1.0000000	1.0316E+02	3.5382E+00
α_2	3.82E-03	1.98E-02	1.69E-02	4.58E-02	0.00E+00	2.1142E+00	1.0458E+02
α_3	4.48E-04	9.16E-03	6.33E-03	2.75E-02	0.00E+00	9.7738E-01	1.0572E+02
α_4	2.31E-06	3.51E-03	1.18E-03	1.49E-02	0.00E+00	3.7439E-01	1.0632E+02
α_5	5.59E-21	6.77E-04	3.83E-07	3.92E-03	0.00E+00	7.2277E-02	1.0663E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9371630	0.9666300	0.9690330	0.9878880	1.0000000	1.2394E+02	4.2787E+00
α_2	3.59E-03	1.75E-02	1.50E-02	3.97E-02	0.00E+00	2.2392E+00	1.2598E+02
α_3	6.27E-04	8.91E-03	6.51E-03	2.54E-02	0.00E+00	1.1418E+00	1.2708E+02
α_4	4.13E-05	4.62E-03	2.42E-03	1.67E-02	0.00E+00	5.9222E-01	1.2763E+02
α_5	7.25E-09	1.73E-03	2.35E-04	8.68E-03	0.00E+00	2.2220E-01	1.2800E+02
α_6	1.10E-18	6.49E-04	1.14E-06	3.79E-03	0.00E+00	8.3237E-02	1.2814E+02

REACTOR TRIP BREAKERS FAIL TO OPEN

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9442790	0.9673660	0.9689360	0.9851010	1.0000000	1.9105E+02	6.4450E+00
α_2	4.41E-03	1.56E-02	1.40E-02	3.23E-02	0.00E+00	3.0878E+00	1.9441E+02
α_3	1.11E-03	8.26E-03	6.67E-03	2.08E-02	0.00E+00	1.6312E+00	1.9586E+02
α_4	2.51E-04	5.01E-03	3.47E-03	1.50E-02	0.00E+00	9.8887E-01	1.9651E+02
α_5	1.30E-05	2.64E-03	1.25E-03	9.98E-03	0.00E+00	5.2177E-01	1.9697E+02
α_6	3.40E-10	9.43E-04	8.05E-05	4.95E-03	0.00E+00	1.8628E-01	1.9731E+02
α_7	0.00E+00	1.47E-04	1.29E-13	5.54E-04	0.00E+00	2.9071E-02	1.9747E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9470850	0.9680050	0.9693380	0.9843870	1.0000000	2.2573E+02	7.4610E+00
α_2	4.32E-03	1.43E-02	1.30E-02	2.90E-02	0.00E+00	3.3447E+00	2.2985E+02
α_3	1.10E-03	7.45E-03	6.10E-03	1.84E-02	0.00E+00	1.7384E+00	2.3145E+02
α_4	3.48E-04	4.92E-03	3.59E-03	1.40E-02	0.00E+00	1.1465E+00	2.3204E+02
α_5	5.53E-05	3.04E-03	1.79E-03	1.03E-02	0.00E+00	7.0833E-01	2.3248E+02
α_6	8.91E-07	1.57E-03	5.15E-04	6.73E-03	0.00E+00	3.6696E-01	2.3282E+02
α_7	6.98E-14	5.27E-04	9.48E-06	3.00E-03	0.00E+00	1.2297E-01	2.3307E+02
α_8	1.31E-42	1.42E-04	2.02E-12	6.00E-04	0.00E+00	3.3124E-02	2.3316E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

Reactor Trip Breakers
REACTOR TRIP BREAKERS FAIL TO OPEN

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	7.00	7.00	7.00	7.00	7.00	7.00	7.00
N_1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N_4			0.0000	0.0000	0.0000	0.0000	0.0000
N_5				0.0000	0.0000	0.0000	0.0000
N_6					0.0000	0.0000	0.0000
N_7						0.0000	0.0000
N_8							0.0000

1.18 Air Compressors

1.18.1 MOTOR DRIVEN AIR COMPRESSOR FAIL TO START

Component :	Compressor
Failure Mode :	Fail to start
Component Group :	Motor Driven
Start Date :	1998/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 234.60
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9805580	0.9940780	0.9963510	0.9998590	0.9971980	1.2888E+02	7.6782E-01
α_2	1.43E-04	5.92E-03	3.65E-03	1.94E-02	2.80E-03	7.6782E-01	1.2888E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9765790	0.9899290	0.9914490	0.9980840	0.9943800	2.0651E+02	2.1009E+00
α_2	1.40E-03	8.79E-03	7.28E-03	2.14E-02	5.62E-03	1.8337E+00	2.0678E+02
α_3	4.44E-08	1.28E-03	2.56E-04	6.08E-03	0.00E+00	2.6722E-01	2.0834E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9736070	0.9864540	0.9875790	0.9954610	0.9915470	2.8074E+02	3.8551E+00
α_2	3.31E-03	1.13E-02	1.02E-02	2.32E-02	8.45E-03	3.2281E+00	2.8137E+02
α_3	1.59E-06	1.42E-03	5.23E-04	5.88E-03	0.00E+00	4.0431E-01	2.8419E+02
α_4	3.35E-09	7.82E-04	1.06E-04	3.92E-03	0.00E+00	2.2267E-01	2.8437E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9750640	0.9859770	0.9867880	0.9941170	0.9932260	3.8941E+02	5.5383E+00
α_2	2.68E-03	8.73E-03	7.91E-03	1.76E-02	4.52E-03	3.4475E+00	3.9150E+02
α_3	5.66E-04	4.16E-03	3.36E-03	1.05E-02	2.26E-03	1.6441E+00	3.9330E+02
α_4	6.20E-07	9.48E-04	3.18E-04	4.03E-03	0.00E+00	3.7439E-01	3.9457E+02
α_5	1.51E-21	1.83E-04	1.03E-07	1.06E-03	0.00E+00	7.2277E-02	3.9488E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9771770	0.9867850	0.9874650	0.9940850	0.9943490	4.6884E+02	6.2787E+00
α_2	1.87E-03	6.58E-03	5.91E-03	1.36E-02	2.51E-03	3.1281E+00	4.7199E+02
α_3	7.76E-04	4.27E-03	3.60E-03	1.01E-02	2.51E-03	2.0307E+00	4.7309E+02
α_4	4.97E-05	1.71E-03	1.09E-03	5.52E-03	6.28E-04	8.1442E-01	4.7430E+02
α_5	1.95E-09	4.68E-04	6.32E-05	2.34E-03	0.00E+00	2.2220E-01	4.7490E+02
α_6	2.96E-19	1.75E-04	3.06E-07	1.02E-03	0.00E+00	8.3237E-02	4.7504E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9971980	0.9943800	0.9915470	0.9932260	0.9943490
α_2	2.80E-03	5.62E-03	8.45E-03	4.52E-03	2.51E-03
α_3		0.00E+00	0.00E+00	2.26E-03	2.51E-03
α_4			0.00E+00	0.00E+00	6.28E-04
α_5				0.00E+00	0.00E+00
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.97E-01	9.94E-01	9.92E-01	9.93E-01	9.94E-01
Beta	2.80E-03	5.62E-03	8.45E-03	6.77E-03	5.65E-03
Gamma		0.00E+00	0.00E+00	3.33E-01	5.56E-01
Delta			0.00E+00	0.00E+00	2.00E-01
Epsilon				0.00E+00	0.00E+00
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	117.30	175.95	234.60	293.25	351.90
N_1	1.3333	1.0000	0.0000	0.0000	0.0000
N_2	0.3333	1.0000	2.0000	1.3333	0.8889
N_3		0.0000	0.0000	0.6667	0.8889
N_4			0.0000	0.0000	0.2222
N_5				0.0000	0.0000
N_6					0.0000

1.18.2 MOTOR DRIVEN AIR COMPRESSOR FAIL TO RUN

Component :	Compressor
Failure Mode :	Fail to Run (Normally running equipment)
Component Group :	Motor Driven
Start Date :	1998/01/01
Data Version :	2012/12/31

Total Number of Independent Failure Events: 577.60
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9883510	0.9945670	0.9951970	0.9986180	0.9953220	5.0670E+02	2.7678E+00
α_2	1.38E-03	5.43E-03	4.80E-03	1.16E-02	4.68E-03	2.7678E+00	5.0670E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9898620	0.9947240	0.9951450	0.9981600	0.9959820	7.7324E+02	4.1009E+00
α_2	9.46E-04	3.65E-03	3.23E-03	7.77E-03	2.68E-03	2.8337E+00	7.7451E+02
α_3	1.41E-04	1.63E-03	1.23E-03	4.49E-03	1.34E-03	1.2672E+00	7.7607E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9914270	0.9953430	0.9956530	0.9981900	0.9969840	1.0377E+03	4.8551E+00
α_2	4.33E-04	2.14E-03	1.83E-03	4.90E-03	1.01E-03	2.2281E+00	1.0403E+03
α_3	3.05E-04	1.83E-03	1.52E-03	4.40E-03	1.51E-03	1.9043E+00	1.0407E+03
α_4	1.35E-05	6.93E-04	4.11E-04	2.33E-03	5.03E-04	7.2267E-01	1.0418E+03

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9916410	0.9951280	0.9953750	0.9977790	0.9975850	1.3356E+03	6.5383E+00
α_2	4.67E-04	1.95E-03	1.71E-03	4.25E-03	4.02E-04	2.6142E+00	1.3395E+03
α_3	3.36E-04	1.66E-03	1.42E-03	3.80E-03	1.01E-03	2.2274E+00	1.3399E+03
α_4	1.03E-04	1.02E-03	7.90E-04	2.75E-03	8.05E-04	1.3744E+00	1.3408E+03
α_5	4.84E-08	2.40E-04	6.55E-05	1.07E-03	2.01E-04	3.2228E-01	1.3418E+03

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9924320	0.9954840	0.9956830	0.9978370	0.9979870	1.6043E+03	7.2786E+00
α_2	3.53E-04	1.54E-03	1.34E-03	3.42E-03	1.68E-04	2.4892E+00	1.6091E+03
α_3	2.25E-04	1.25E-03	1.05E-03	2.96E-03	5.87E-04	2.0168E+00	1.6096E+03
α_4	1.54E-04	1.07E-03	8.68E-04	2.65E-03	7.55E-04	1.7172E+00	1.6099E+03
α_5	1.72E-05	5.26E-04	3.39E-04	1.67E-03	4.19E-04	8.4720E-01	1.6107E+03
α_6	2.30E-10	1.29E-04	1.49E-05	6.59E-04	8.39E-05	2.0824E-01	1.6114E+03

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9953220	0.9959820	0.9969840	0.9975850	0.9979870
α_2	4.68E-03	2.68E-03	1.01E-03	4.02E-04	1.68E-04
α_3		1.34E-03	1.51E-03	1.01E-03	5.87E-04
α_4			5.03E-04	8.05E-04	7.55E-04
α_5				2.01E-04	4.19E-04
α_6					8.39E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.95E-01	9.96E-01	9.97E-01	9.98E-01	9.98E-01
Beta	4.68E-03	4.02E-03	3.02E-03	2.41E-03	2.01E-03
Gamma		3.33E-01	6.67E-01	8.33E-01	9.17E-01
Delta			2.50E-01	5.00E-01	6.82E-01
Epsilon				2.00E-01	4.00E-01
Mu					1.67E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	495.79	743.69	991.59	1239.48	1487.38
N_1	0.6667	0.0000	0.0000	0.0000	0.0000
N_2	2.3333	2.0000	1.0000	0.5000	0.2500
N_3		1.0000	1.5000	1.2500	0.8750
N_4			0.5000	1.0000	1.1250
N_5				0.2500	0.6250
N_6					0.1250

2 No Data (Prior Only)

2.1.1.1 No Data

The section labeled No Data (Prior Only) shows the prior used in the CCF database. This is the result of calculating an application without any data, which is the same as calculating an application with all the events in the CCF database. These CCF parameters may be used for those cases where there is no reasonable set of data to approximate the intended event.

2.2 Generic Distributions

2.2.1 Generic Demand CCF Distribution

2.2.1.1 ALL CCF DEMAND BASED EVENTS 1997 TO CURRENT SPAR: CCF-DEM

Failure Mode : Fail to close (reseat) on demand
Fail to Open/Close Mode Unspecified (demand based)
Fail to open on demand
Fail to start
Fail to Load/Run
Fail to stop
Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 3104.30
Total Number of Common-Cause Failure Events: 102

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9707550	0.9781220	0.9783890	0.9845880	0.9782910	1.1730E+03	2.6237E+01
α_2	1.54E-02	2.19E-02	2.16E-02	2.92E-02	2.17E-02	2.6237E+01	1.1730E+03

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9704140	0.9765760	0.9767500	0.9821350	0.9767940	1.7510E+03	4.1999E+01
α_2	1.16E-02	1.62E-02	1.60E-02	2.13E-02	1.60E-02	2.8978E+01	1.7640E+03
α_3	4.31E-03	7.26E-03	7.08E-03	1.08E-02	7.24E-03	1.3021E+01	1.7800E+03

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9698830	0.9753330	0.9754690	0.9803240	0.9756210	2.3202E+03	5.8679E+01
α_2	1.18E-02	1.57E-02	1.56E-02	2.02E-02	1.55E-02	3.7438E+01	2.3414E+03
α_3	3.62E-03	5.96E-03	5.82E-03	8.77E-03	5.91E-03	1.4181E+01	2.3647E+03
α_4	1.40E-03	2.97E-03	2.83E-03	5.01E-03	2.93E-03	7.0597E+00	2.3718E+03

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9730170	0.9776340	0.9777440	0.9818860	0.9780860	2.9304E+03	6.7040E+01
α_2	8.24E-03	1.12E-02	1.11E-02	1.45E-02	1.09E-02	3.3592E+01	2.9638E+03
α_3	4.22E-03	6.42E-03	6.31E-03	8.99E-03	6.30E-03	1.9244E+01	2.9782E+03
α_4	1.96E-03	3.53E-03	3.42E-03	5.48E-03	3.52E-03	1.0587E+01	2.9869E+03
α_5	3.83E-04	1.21E-03	1.10E-03	2.40E-03	1.22E-03	3.6167E+00	2.9938E+03

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9753380	0.9793890	0.9794810	0.9831360	0.9799030	3.5107E+03	7.3882E+01
α_2	6.25E-03	8.63E-03	8.54E-03	1.13E-02	8.28E-03	3.0929E+01	3.5537E+03
α_3	3.92E-03	5.84E-03	5.75E-03	8.08E-03	5.72E-03	2.0938E+01	3.5636E+03
α_4	2.10E-03	3.56E-03	3.47E-03	5.34E-03	3.52E-03	1.2773E+01	3.5718E+03
α_5	9.73E-04	2.03E-03	1.94E-03	3.41E-03	2.04E-03	7.2915E+00	3.5773E+03
α_6	9.37E-05	5.44E-04	4.55E-04	1.30E-03	5.39E-04	1.9509E+00	3.5826E+03

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9771660	0.9807650	0.9808440	0.9841110	0.9814550	4.1375E+03	8.1145E+01
α_2	5.19E-03	7.19E-03	7.11E-03	9.45E-03	6.76E-03	3.0330E+01	4.1883E+03
α_3	3.24E-03	4.85E-03	4.77E-03	6.73E-03	4.68E-03	2.0467E+01	4.1982E+03
α_4	2.15E-03	3.49E-03	3.42E-03	5.11E-03	3.41E-03	1.4740E+01	4.2039E+03
α_5	1.25E-03	2.31E-03	2.24E-03	3.65E-03	2.29E-03	9.7630E+00	4.2089E+03
α_6	4.39E-04	1.14E-03	1.06E-03	2.11E-03	1.15E-03	4.8083E+00	4.2138E+03
α_7	1.37E-05	2.46E-04	1.73E-04	7.27E-04	2.50E-04	1.0362E+00	4.2176E+03

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9786350	0.9819010	0.9819650	0.9849440	0.9826340	4.7312E+03	8.7210E+01
α_2	4.54E-03	6.29E-03	6.23E-03	8.28E-03	5.88E-03	3.0325E+01	4.7881E+03
α_3	2.69E-03	4.07E-03	4.00E-03	5.68E-03	3.89E-03	1.9601E+01	4.7988E+03
α_4	1.93E-03	3.12E-03	3.06E-03	4.55E-03	3.03E-03	1.5052E+01	4.8034E+03
α_5	1.34E-03	2.36E-03	2.29E-03	3.61E-03	2.32E-03	1.1349E+01	4.8071E+03
α_6	7.16E-04	1.50E-03	1.43E-03	2.52E-03	1.50E-03	7.2366E+00	4.8112E+03
α_7	1.75E-04	6.33E-04	5.66E-04	1.32E-03	6.38E-04	3.0513E+00	4.8154E+03
α_8	1.12E-06	1.23E-04	6.45E-05	4.45E-04	1.22E-04	5.9462E-01	4.8178E+03

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9782910	0.9767940	0.9756210	0.9780860	0.9799030	0.9814550	0.9826340
α_2	2.17E-02	1.60E-02	1.55E-02	1.09E-02	8.28E-03	6.76E-03	5.88E-03
α_3		7.24E-03	5.91E-03	6.30E-03	5.72E-03	4.68E-03	3.89E-03
α_4			2.93E-03	3.52E-03	3.52E-03	3.41E-03	3.03E-03
α_5				1.22E-03	2.04E-03	2.29E-03	2.32E-03
α_6					5.39E-04	1.15E-03	1.50E-03
α_7						2.50E-04	6.38E-04
α_8							1.22E-04

ALL CCF RATE BASED EVENTS 1997 TO CURRENT SPAR: CCF-RATE

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.78E-01	9.77E-01	9.76E-01	9.78E-01	9.80E-01	9.81E-01	9.83E-01
Beta	2.17E-02	2.32E-02	2.44E-02	2.19E-02	2.01E-02	1.85E-02	1.74E-02
Gamma		3.12E-01	3.63E-01	5.04E-01	5.88E-01	6.35E-01	6.62E-01
Delta			3.32E-01	4.30E-01	5.16E-01	6.03E-01	6.61E-01
Epsilon				2.58E-01	4.23E-01	5.20E-01	6.02E-01
Mu					2.09E-01	3.79E-01	4.93E-01
Upsilon						1.79E-01	3.37E-01
Sigma							1.61E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	1116.65	1674.98	2233.31	2791.64	3349.96	3908.29	4466.62
N_1	46.0845	46.4830	40.7432	42.5828	43.7761	45.1261	45.8027
N_2	25.8021	28.1439	36.2096	31.4776	28.6895	27.2420	26.9800
N_3		12.7541	13.7769	18.2663	19.7963	18.8362	17.8622
N_4			6.8370	10.2122	12.1803	13.7513	13.9059
N_5				3.5444	7.0693	9.2412	10.6411
N_6					1.8677	4.6220	6.8696
N_7						1.0071	2.9283
N_8							0.5615

2.2.2 Generic Rate CCF Distribution

2.2.2.1 ALL CCF RATE BASED EVENTS 1997 TO CURRENT SPAR: CCF-RATE

Failure Mode : Spurious operation open or close
Fail to Run (Normally running equipment)
Filter media allows the pass through of debris
Failure of Control Function Only
High dP across filter
Fail to Run >1 Hour (Standby equipment)
Fail to control flow
Fail to Run less than 1 Hour
Fail to Operate (General operation failure, rate based)

Loss of heat transfer capabilities in heat exchangers

No flow/plugged

Start Date : 1997/01/01
Data Version : 2012/12/31

Total Number of Independent Failure Events: 2658.10
Total Number of Common-Cause Failure Events: 108

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9555480	0.9644040	0.9646440	0.9724410	0.9644470	1.2489E+03	4.6097E+01
α_2	2.76E-02	3.56E-02	3.54E-02	4.45E-02	3.56E-02	4.6097E+01	1.2489E+03

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9596820	0.9666770	0.9668420	0.9731210	0.9667200	1.8600E+03	6.4117E+01
α_2	1.41E-02	1.89E-02	1.87E-02	2.43E-02	1.88E-02	3.6365E+01	1.8878E+03
α_3	1.03E-02	1.44E-02	1.43E-02	1.92E-02	1.45E-02	2.7752E+01	1.8964E+03

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9633270	0.9691590	0.9692800	0.9745740	0.9693100	2.4685E+03	7.8553E+01
α_2	1.07E-02	1.43E-02	1.42E-02	1.84E-02	1.41E-02	3.6446E+01	2.5106E+03
α_3	6.90E-03	9.89E-03	9.76E-03	1.33E-02	9.92E-03	2.5196E+01	2.5219E+03
α_4	4.23E-03	6.64E-03	6.51E-03	9.49E-03	6.68E-03	1.6911E+01	2.5301E+03

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9679240	0.9728100	0.9729050	0.9773640	0.9730770	3.1156E+03	8.7082E+01
α_2	7.06E-03	9.73E-03	9.63E-03	1.27E-02	9.36E-03	3.1158E+01	3.1715E+03
α_3	5.86E-03	8.31E-03	8.21E-03	1.11E-02	8.26E-03	2.6614E+01	3.1761E+03
α_4	3.62E-03	5.60E-03	5.49E-03	7.92E-03	5.65E-03	1.7920E+01	3.1848E+03
α_5	2.02E-03	3.56E-03	3.45E-03	5.44E-03	3.65E-03	1.1390E+01	3.1913E+03

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9714630	0.9756960	0.9757760	0.9796470	0.9760550	3.7341E+03	9.3015E+01
α_2	4.78E-03	6.81E-03	6.72E-03	9.13E-03	6.43E-03	2.6061E+01	3.8011E+03
α_3	4.77E-03	6.80E-03	6.72E-03	9.12E-03	6.72E-03	2.6036E+01	3.8011E+03
α_4	3.58E-03	5.36E-03	5.28E-03	7.44E-03	5.38E-03	2.0517E+01	3.8066E+03
α_5	1.74E-03	3.04E-03	2.95E-03	4.63E-03	3.08E-03	1.1627E+01	3.8155E+03
α_6	1.19E-03	2.29E-03	2.21E-03	3.69E-03	2.35E-03	8.7739E+00	3.8183E+03

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9743460	0.9780530	0.9781220	0.9815230	0.9785790	4.3999E+03	9.8731E+01
α_2	3.64E-03	5.29E-03	5.21E-03	7.18E-03	4.80E-03	2.3781E+01	4.4748E+03
α_3	3.52E-03	5.14E-03	5.06E-03	7.01E-03	4.99E-03	2.3108E+01	4.4755E+03
α_4	3.13E-03	4.66E-03	4.59E-03	6.45E-03	4.64E-03	2.0984E+01	4.4776E+03
α_5	2.23E-03	3.55E-03	3.48E-03	5.12E-03	3.59E-03	1.5969E+01	4.4827E+03
α_6	1.21E-03	2.22E-03	2.15E-03	3.49E-03	2.28E-03	9.9932E+00	4.4886E+03
α_7	4.24E-04	1.09E-03	1.02E-03	2.00E-03	1.13E-03	4.8954E+00	4.4937E+03

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9766000	0.9799240	0.9799840	0.9830350	0.9805190	5.0330E+03	1.0311E+02
α_2	3.02E-03	4.43E-03	4.36E-03	6.05E-03	3.95E-03	2.2735E+01	5.1134E+03
α_3	2.51E-03	3.80E-03	3.74E-03	5.32E-03	3.62E-03	1.9535E+01	5.1166E+03
α_4	2.64E-03	3.97E-03	3.91E-03	5.51E-03	3.92E-03	2.0387E+01	5.1157E+03
α_5	2.14E-03	3.35E-03	3.29E-03	4.78E-03	3.36E-03	1.7216E+01	5.1189E+03
α_6	1.52E-03	2.55E-03	2.49E-03	3.81E-03	2.60E-03	1.3117E+01	5.1230E+03
α_7	6.59E-04	1.39E-03	1.33E-03	2.34E-03	1.43E-03	7.1431E+00	5.1290E+03
α_8	1.57E-04	5.80E-04	5.17E-04	1.22E-03	6.00E-04	2.9799E+00	5.1331E+03

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9644470	0.9667200	0.9693100	0.9730770	0.9760550	0.9785790	0.9805190
α_2	3.56E-02	1.88E-02	1.41E-02	9.36E-03	6.43E-03	4.80E-03	3.95E-03
α_3		1.45E-02	9.92E-03	8.26E-03	6.72E-03	4.99E-03	3.62E-03
α_4			6.68E-03	5.65E-03	5.38E-03	4.64E-03	3.92E-03
α_5				3.65E-03	3.08E-03	3.59E-03	3.36E-03
α_6					2.35E-03	2.28E-03	2.60E-03
α_7						1.13E-03	1.43E-03
α_8							6.00E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.64E-01	9.67E-01	9.69E-01	9.73E-01	9.76E-01	9.79E-01	9.81E-01
Beta	3.56E-02	3.33E-02	3.07E-02	2.69E-02	2.39E-02	2.14E-02	1.95E-02
Gamma		4.36E-01	5.41E-01	6.52E-01	7.32E-01	7.76E-01	7.97E-01
Delta			4.02E-01	5.30E-01	6.17E-01	7.00E-01	7.67E-01
Epsilon				3.92E-01	5.02E-01	6.01E-01	6.71E-01
Mu					4.32E-01	4.87E-01	5.79E-01
Upsilon						3.32E-01	4.39E-01
Sigma							2.96E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
Adj. Ind. Events	1194.65	1791.98	2389.30	2986.63	3583.96	4181.28	4778.61
N_1	44.0296	38.5133	33.1087	32.8294	33.1644	34.5504	35.6392
N_2	45.6622	35.5310	35.2178	29.0436	23.8217	20.6930	19.3904
N_3		27.4852	24.7919	25.6367	24.8939	21.4772	17.7962
N_4			16.6882	17.5454	19.9245	19.9951	19.2401
N_5				11.3174	11.4048	15.4468	16.5077
N_6					8.6907	9.8069	12.7502
N_7						4.8663	7.0201
N_8							2.9468

2.2.3 CCF Prior Distribution

2.2.3.1 No Data (Prior Only)

Data Version : 2007/12/31

Total Number of Independent Failure Events: 0
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8993200	0.9742690	0.9887700	0.9999290	----	1.7418E+01	4.6002E-01
α_2	6.65E-05	2.57E-02	1.12E-02	1.00E-01	----	4.6002E-01	1.7418E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9306240	0.9755060	0.9819700	0.9982830	----	4.5105E+01	1.1325E+00
α_2	6.61E-04	1.87E-02	1.23E-02	5.84E-02	----	8.6476E-01	4.5372E+01
α_3	2.07E-07	5.79E-03	1.17E-03	2.74E-02	----	2.6776E-01	4.5969E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9380870	0.9740820	0.9782970	0.9956540	----	7.0868E+01	1.8856E+00
α_2	1.43E-03	1.70E-02	1.28E-02	4.69E-02	----	1.2400E+00	7.1513E+01
α_3	9.66E-06	5.89E-03	2.32E-03	2.38E-02	----	4.2870E-01	7.2324E+01
α_4	9.21E-09	2.98E-03	3.83E-04	1.50E-02	----	2.1695E-01	7.2536E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9521790	0.9760740	0.9782400	0.9925770	----	1.4106E+02	3.4576E+00
α_2	2.59E-03	1.41E-02	1.19E-02	3.30E-02	----	2.0400E+00	1.4247E+02
α_3	3.01E-04	6.59E-03	4.50E-03	2.00E-02	----	9.5369E-01	1.4356E+02
α_4	2.21E-06	2.67E-03	9.37E-04	1.12E-02	----	3.8684E-01	1.4413E+02
α_5	5.61E-20	5.33E-04	5.18E-07	3.10E-03	----	7.7129E-02	1.4444E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9553700	0.9762820	0.9779970	0.9913440	----	1.7893E+02	4.3470E+00
α_2	2.60E-03	1.24E-02	1.07E-02	2.81E-02	----	2.2804E+00	1.8099E+02
α_3	4.16E-04	6.13E-03	4.45E-03	1.75E-02	----	1.1245E+00	1.8215E+02
α_4	3.82E-05	3.40E-03	1.85E-03	1.20E-02	----	6.2471E-01	1.8265E+02
α_5	1.60E-08	1.32E-03	2.18E-04	6.46E-03	----	2.4272E-01	1.8303E+02
α_6	1.26E-20	4.07E-04	3.05E-07	2.36E-03	----	7.4722E-02	1.8320E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9603690	0.9769760	0.9781320	0.9896440	----	2.6720E+02	6.2971E+00
α_2	3.14E-03	1.12E-02	1.00E-02	2.33E-02	----	3.0721E+00	2.7042E+02
α_3	6.66E-04	5.55E-03	4.40E-03	1.43E-02	----	1.5182E+00	2.7197E+02
α_4	1.58E-04	3.48E-03	2.37E-03	1.06E-02	----	9.5310E-01	2.7254E+02
α_5	1.00E-05	1.93E-03	9.22E-04	7.26E-03	----	5.2795E-01	2.7296E+02
α_6	4.58E-10	7.08E-04	6.75E-05	3.68E-03	----	1.9373E-01	2.7330E+02
α_7	5.03E-44	1.17E-04	8.41E-13	4.81E-04	----	3.2027E-02	2.7346E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9622170	0.9773660	0.9783580	0.9891370	----	3.1221E+02	7.2302E+00
α_2	3.13E-03	1.04E-02	9.45E-03	2.12E-02	----	3.3414E+00	3.1609E+02
α_3	6.67E-04	5.04E-03	4.06E-03	1.28E-02	----	1.6130E+00	3.1782E+02
α_4	1.86E-04	3.26E-03	2.30E-03	9.62E-03	----	1.0438E+00	3.1839E+02
α_5	3.88E-05	2.20E-03	1.28E-03	7.47E-03	----	7.0280E-01	3.1873E+02
α_6	5.77E-07	1.13E-03	3.63E-04	4.86E-03	----	3.6184E-01	3.1907E+02
α_7	1.19E-13	3.98E-04	8.44E-06	2.25E-03	----	1.2739E-01	3.1931E+02
α_8	5.47E-36	1.25E-04	5.43E-11	6.01E-04	----	4.0005E-02	3.1940E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
α_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_3		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_5				0.00E+00	0.00E+00	0.00E+00	0.00E+00
α_6					0.00E+00	0.00E+00	0.00E+00
α_7						0.00E+00	0.00E+00
α_8							0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Beta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gamma		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Delta			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Epsilon				0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mu					0.00E+00	0.00E+00	0.00E+00
Upsilon						0.00E+00	0.00E+00
Sigma							0.00E+00

3 Glossary

Application
A particular set of CCF events selected from the CCF database for use in a specific study.

Average Impact Vector
An average over the impact vectors for different hypotheses regarding the number of components failed in an event.

Available
The component is available if it is capable of performing its function according to a specified success criterion.

Basic Event
An event in a reliability logic model that represents the state in which a component or group of components is unavailable and does not require further development in terms of contributing causes.

Common Cause Event
A dependent failure in which two or more component fault states exist simultaneously, or within a short time interval, and are a direct result of a shared cause.

Common Cause Basic Event
In system modeling, a basic event that represents the unavailability of a specific set of components because of shared causes that are not explicitly represented in the system logic model as other basic events.

Common Cause Component Group
A group of (usually similar [in mission, manufacturer, maintenance, environment, etc.]) components that are considered to have a high potential for failure due to the same cause or causes.

Common Cause Failure Model
The basis for quantifying the frequency of common cause events. Examples include the beta factor, alpha factor, and basic parameter, and the binomial failure rate models.

Complete Common Cause Failure
A CCF in which all redundant components are failed simultaneously as a direct result of a shared cause; i.e., the component degradation value equals 1.0 for all components, and both the timing factor and the shared cause factor are equal to 1.0.

Component
An element of plant hardware designed to provide a particular function.

Component Boundary
The component boundary encompasses the set of piece parts that are considered to form the component.

Component Degradation Value (p)
The assessed probability ($0.0 = p = 1.0$) that a functionally or physically degraded component would fail to complete the mission.

Component State
Component state defines the component status in regard to its intended function. Two general categories of component states are defined as available and unavailable.

Timing Factor (q)
The probability ($0.0 = q = 1.0$) that two or more component failures (or degraded states) separated in time represent a CCF. This can be viewed as an indication of the strength-of-coupling in synchronizing failure times.

Unavailable
The component is unavailable if the component is unable to perform its intended function according to a stated success criterion. Two subsets of unavailable states are failure and functionally unavailable.

Exposed Population
The set of components within the plant that are potentially affected by the CCF under consideration.

Failure
The component is not capable of performing its specified operation according to a success criterion.

Functionally Unavailable
The component is capable of operation, but the function normally provided by the component is unavailable due to lack of proper input, lack of support function from a source outside the component (i.e., motive power, actuation signal), maintenance, testing, the improper interference of a person, etc.

Potentially Unavailable
The component is capable of performing its function according to a success criterion, but an incipient or degraded condition exists. (N.B., potentially unavailable is not synonymous with hypothetical.)

Defense
Any operational, maintenance, and design measures taken to diminish the frequency and/or consequences of CCFs.

Degraded
The component is in such a state that it exhibits reduced performance but insufficient degradation to declare the component unavailable according to the specified success criterion.

Impact Vector
An assessment of the impact an event would have on a common cause component group. The impact is usually measured as the number of failed components out of a set of similar components in the common cause component group.

Incipient
The component is in a condition that, if left unremedied, could ultimately lead to a degraded or unavailable state.

Reliability Logic Model
A logical representation of the combinations of component states that could lead to system failure. A fault tree is an example of a system logic model.

Root Cause
The most basic reason for a component failure, which, if corrected, could prevent recurrence. The identified root cause may vary depending on the particular defensive strategy adopted against the failure mechanism.

Shared Cause Factor/Mechanism
A set of causes and factors characterizing why and how a failure is systematically induced in several components.

Failure Mechanism
The history describing the events and influences leading to a given failure.

Failure Mode
A description of component failure in terms of the component function that was actually or potentially unavailable.

Failure Mode Applicability
The analyst's probability that the specified component failure mode for a given event is appropriate to the particular application.

Mapping
The impact vector of an event must be "mapped up" or "mapped down" when the exposed population of the target plant is higher or lower than that of the original plant that experienced the CCF. The end result of mapping an impact vector is an adjusted impact vector applicable to the target plant.

Mapping up Factor
A factor used to adjust the impact vector of an event when the exposed population of the target plan is higher than that of the original plant that experienced the CCF.

Potential Common Cause Failure
Any common cause event in which at least one component degradation value is less than 1.0.

Proximate Cause
A characterization of the condition that is readily identified as leading to failure of the component. It might alternatively be characterized as a symptom.

Shared-Cause Factor (c)
A number that reflects the analyst's uncertainty ($0.0 = c = 1.0$) about the existence of coupling among the failures of two or more components, i.e., whether a shared cause of failure can be clearly identified.

Shock
A shock is an event that occurs at a random point in time and acts on the system; i.e., all the components in the system simultaneously. There are two kinds of shocks distinguished by the potential impact of the shock event, i.e., lethal and non-lethal.

System
The entity that encompasses an interacting collection of components to provide a particular function or functions.