CCF Parameter Estimations 2009

U.S. Nuclear Regulatory Commission, "CCF Parameter Estimations, 2009 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.

1/31/2011

CCF Parameter Estimations 2009

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 2009 update to NUREG/CR-5496, updating data and parameter estimations.

This release, CCF Parameter Estimation for 2009, reflects the CCF data contained within the CCF database, Version 4.5.2009. This version of the CCF database contains data from 1997 to 2009.

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, 2009 Update", http://nrcoe.inl.gov/results/CCF/ParamEst2009/ccfparamest.htm, January 2011.

TABLE OF CONTENTS

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 2009 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 Motor Driven Pumps

1.1.1 Pooled Motor Driven Pump Distributions

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

Component : Motor Driven Pump
Failure Mode : Fail to run
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 396.90
Total Number of Common-Cause Failure Events: 19

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9536190	0.9721570	0.9733550	0.9865990	0.9727060	2.5323E+02	7.2525E+00
α_2	1.34E-02	2.78E-02	2.66E-02	4.64E-02	2.73E-02	7.2525E+00	2.5323E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9547500	0.9699750	0.9707530	0.9825410	0.9704650	3.8789E+02	1.2007E+01
α_2	9.96E-03	1.99E-02	1.91E-02	3.26E-02	1.93E-02	7.9653E+00	3.9193E+02
α_3	3.49E-03	1.01E-02	9.30E-03	1.95E-02	1.02E-02	4.0414E+00	3.9586E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9577010	0.9706080	0.9711940	0.9815200	0.9715190	5.1994E+02	1.5745E+01
α_2	8.12E-03	1.58E-02	1.52E-02	2.56E-02	1.49E-02	8.4882E+00	5.2720E+02
α_3	4.02E-03	9.86E-03	9.26E-03	1.78E-02	1.00E-02	5.2813E+00	5.3040E+02
α_4	6.47E-04	3.69E-03	3.09E-03	8.77E-03	3.59E-03	1.9755E+00	5.3371E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9620780	0.9728390	0.9732830	0.9820800	0.9742100	6.8625E+02	1.9159E+01
α_2	6.34E-03	1.23E-02	1.18E-02	1.98E-02	1.08E-02	8.6636E+00	6.9675E+02
α_3	3.51E-03	8.20E-03	7.74E-03	1.45E-02	7.93E-03	5.7817E+00	6.9963E+02
α_4	1.75E-03	5.34E-03	4.88E-03	1.05E-02	5.60E-03	3.7664E+00	7.0164E+02
α_5	6.01E-05	1.34E-03	9.12E-04	4.10E-03	1.45E-03	9.4768E-01	7.0446E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9650740	0.9745740	0.9749500	0.9827930	0.9762280	8.2316E+02	2.1476E+01
α_2	5.09E-03	9.98E-03	9.60E-03	1.62E-02	8.56E-03	8.4320E+00	8.3620E+02
α_3	2.90E-03	6.79E-03	6.41E-03	1.20E-02	6.35E-03	5.7385E+00	8.3890E+02
α_4	1.86E-03	5.14E-03	4.75E-03	9.73E-03	5.18E-03	4.3392E+00	8.4030E+02
α_5	6.49E-04	2.89E-03	2.51E-03	6.45E-03	3.07E-03	2.4452E+00	8.4219E+02
α_6	3.00E-06	6.17E-04	2.91E-04	2.33E-03	6.05E-04	5.2084E-01	8.4411E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9727060	0.9704650	0.9715190	0.9742100	0.9762280
α_2	2.73E-02	1.93E-02	1.49E-02	1.08E-02	8.56E-03
α_3		1.02E-02	1.00E-02	7.93E-03	6.35E-03
α_4			3.59E-03	5.60E-03	5.18E-03
α_5				1.45E-03	3.07E-03
α_6					6.05E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.73E-01	9.70E-01	9.72E-01	9.74E-01	9.76E-01
Beta	2.73E-02	2.95E-02	2.85E-02	2.58E-02	2.38E-02
Gamma		3.46E-01	4.77E-01	5.81E-01	6.40E-01
Delta			2.64E-01	4.70E-01	5.82E-01
Epsilon				2.05E-01	4.15E-01
Mu					1.64E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	232.11	348.16	464.21	580.26	696.32
N_1	10.8740	10.1795	9.5936	9.8282	9.9024
N_2	6.8180	7.1316	7.2601	6.5494	6.1928
N_3		3.7742	4.8770	4.8043	4.5967
N_4			1.7528	3.3920	3.7470
N_5				0.8754	2.2230
N_6					0.4376

1.1.1.2 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 : 2009/12/31

Total Number of Independent Failure Events: 529.80
Total Number of Common-Cause Failure Events: 22

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9621550	0.9764360	0.9772950	0.9877860	0.9769470	3.5996E+02	8.6868E+00
α_2	1.22E-02	2.36E-02	2.27E-02	3.78E-02	2.31E-02	8.6868E+00	3.5996E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9654570	0.9767740	0.9773400	0.9861720	0.9775060	5.4859E+02	1.3045E+01
α_2	7.59E-03	1.49E-02	1.43E-02	2.42E-02	1.42E-02	8.3706E+00	5.5326E+02
α_3	3.16E-03	8.32E-03	7.75E-03	1.55E-02	8.30E-03	4.6739E+00	5.5696E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9666910	0.9764500	0.9768700	0.9847690	0.9774830	7.3301E+02	1.7678E+01
α_2	7.74E-03	1.40E-02	1.36E-02	2.17E-02	1.32E-02	1.0495E+01	7.4019E+02
α_3	2.44E-03	6.35E-03	5.92E-03	1.17E-02	6.21E-03	4.7679E+00	7.4592E+02
α_4	7.13E-04	3.22E-03	2.79E-03	7.19E-03	3.12E-03	2.4155E+00	7.4827E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9707900	0.9788840	0.9792140	0.9858630	0.9805240	9.5325E+02	2.0563E+01
α_2	5.12E-03	9.63E-03	9.29E-03	1.53E-02	8.31E-03	9.3749E+00	9.6444E+02
α_3	2.97E-03	6.58E-03	6.24E-03	1.13E-02	6.21E-03	6.4046E+00	9.6741E+02
α_4	1.18E-03	3.71E-03	3.38E-03	7.39E-03	3.71E-03	3.6161E+00	9.7020E+02
α_5	8.78E-05	1.20E-03	8.79E-04	3.40E-03	1.25E-03	1.1670E+00	9.7265E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9737230	0.9807670	0.9810390	0.9868760	0.9826300	1.1441E+03	2.2435E+01
α_2	3.65E-03	7.18E-03	6.90E-03	1.17E-02	5.87E-03	8.3787E+00	1.1582E+03
α_3	2.53E-03	5.57E-03	5.29E-03	9.56E-03	5.12E-03	6.4957E+00	1.1600E+03
α_4	1.45E-03	3.90E-03	3.62E-03	7.30E-03	3.78E-03	4.5476E+00	1.1620E+03
α_5	4.46E-04	2.04E-03	1.77E-03	4.59E-03	2.07E-03	2.3832E+00	1.1642E+03
α_6	6.26E-06	5.40E-04	2.94E-04	1.91E-03	5.23E-04	6.3024E-01	1.1659E+03

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9769470	0.9775060	0.9774830	0.9805240	0.9826300
α_2	2.31E-02	1.42E-02	1.32E-02	8.31E-03	5.87E-03
α_3		8.30E-03	6.21E-03	6.21E-03	5.12E-03
α_4			3.12E-03	3.71E-03	3.78E-03
α_5				1.25E-03	2.07E-03
α_6					5.23E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.77E-01	9.78E-01	9.77E-01	9.81E-01	9.83E-01
Beta	2.31E-02	2.25E-02	2.25E-02	1.95E-02	1.74E-02
Gamma		3.69E-01	4.14E-01	5.74E-01	6.62E-01
Delta			3.34E-01	4.44E-01	5.54E-01
Epsilon				2.52E-01	4.06E-01
Mu					2.02E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	337.45	506.18	674.90	843.63	1012.36
N_1	12.2620	12.8561	11.9692	13.4597	14.7926
N_2	8.2523	7.5369	9.2664	7.2607	6.1395
N_3		4.4067	4.3636	5.4272	5.3539
N_4			2.1928	3.2417	3.9554
N_5				1.0947	2.1610
N_6					0.5470

1.1.1.3 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 : 2009/12/31

Total Number of Independent Failure Events: 48.50
Total Number of Common-Cause Failure Events: 5

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8895190	0.9505100	0.9569410	0.9894700	0.9478340	4.3556E+01	2.2678E+00
α_2	1.05E-02	4.95E-02	4.31E-02	1.10E-01	5.22E-02	2.2678E+00	4.3556E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8965980	0.9436340	0.9472350	0.9783620	0.9313320	7.7025E+01	4.6009E+00
α_2	1.59E-02	4.70E-02	4.33E-02	9.05E-02	5.89E-02	3.8337E+00	7.7792E+01
α_3	2.27E-04	9.40E-03	5.81E-03	3.08E-02	9.81E-03	7.6722E-01	8.0859E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9026540	0.9422510	0.9448150	0.9730790	0.9284420	1.0777E+02	6.6051E+00
α_2	1.53E-02	4.02E-02	3.76E-02	7.42E-02	5.08E-02	4.6031E+00	1.0977E+02
α_3	1.64E-03	1.34E-02	1.07E-02	3.44E-02	1.69E-02	1.5293E+00	1.1285E+02
α_4	1.20E-05	4.13E-03	1.80E-03	1.62E-02	3.77E-03	4.7267E-01	1.1390E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9246090	0.9529350	0.9545910	0.9755960	0.9388120	1.7288E+02	8.5384E+00
α_2	9.40E-03	2.50E-02	2.33E-02	4.66E-02	2.97E-02	4.5413E+00	1.7688E+02
α_3	3.90E-03	1.53E-02	1.35E-02	3.26E-02	2.19E-02	2.7691E+00	1.7865E+02
α_4	3.16E-04	5.68E-03	4.00E-03	1.68E-02	8.03E-03	1.0307E+00	1.8039E+02
α_5	9.16E-10	1.09E-03	1.09E-04	5.63E-03	1.53E-03	1.9728E-01	1.8122E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9315910	0.9564090	0.9577960	0.9764850	0.9460470	2.0872E+02	9.5130E+00
α_2	6.55E-03	1.87E-02	1.73E-02	3.59E-02	1.91E-02	4.0890E+00	2.1414E+02
α_3	3.83E-03	1.39E-02	1.24E-02	2.89E-02	1.94E-02	3.0229E+00	2.1521E+02
α_4	1.04E-03	7.56E-03	6.12E-03	1.90E-02	1.09E-02	1.6504E+00	2.1658E+02
α_5	2.71E-05	2.77E-03	1.47E-03	9.93E-03	3.95E-03	6.0500E-01	2.1763E+02
α_6	3.41E-12	6.68E-04	2.49E-05	3.70E-03	6.44E-04	1.4574E-01	2.1809E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9478340	0.9313320	0.9284420	0.9388120	0.9460470
α_2	5.22E-02	5.89E-02	5.08E-02	2.97E-02	1.91E-02
α_3		9.81E-03	1.69E-02	2.19E-02	1.94E-02
α_4			3.77E-03	8.03E-03	1.09E-02
α_5				1.53E-03	3.95E-03
α_6					6.44E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.48E-01	9.31E-01	9.28E-01	9.39E-01	9.46E-01
Beta	5.22E-02	6.87E-02	7.16E-02	6.12E-02	5.40E-02
Gamma		1.43E-01	2.89E-01	5.15E-01	6.47E-01
Delta			1.82E-01	3.04E-01	4.44E-01
Epsilon				1.60E-01	2.96E-01
Mu					1.40E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	30.31	45.47	60.63	75.78	90.94
N_1	3.0000	2.0000	1.0000	0.9375	0.8438
N_2	1.8333	3.0000	3.3750	2.4271	1.8498
N_3		0.5000	1.1250	1.7917	1.8811
N_4			0.2500	0.6563	1.0582
N_5				0.1250	0.3828
N_6					0.0625

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

Component :	Motor Driven Pump
Failure Mode :	Fail to run Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 445.40
Total Number of Common-Cause Failure Events: 24

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9513570	0.9693830	0.9704350	0.9838250	0.9697590	2.8767E+02	9.0858E+00
α_2	1.62E-02	3.06E-02	2.96E-02	4.86E-02	3.02E-02	9.0858E+00	2.8767E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9506120	0.9657370	0.9664240	0.9785220	0.9658560	4.3706E+02	1.5506E+01
α_2	1.37E-02	2.42E-02	2.35E-02	3.72E-02	2.40E-02	1.0965E+01	4.4160E+02
α_3	3.74E-03	1.00E-02	9.32E-03	1.88E-02	1.01E-02	4.5414E+00	4.4802E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9531700	0.9660860	0.9666030	0.9772530	0.9664950	5.8383E+02	2.0495E+01
α_2	1.13E-02	1.96E-02	1.91E-02	2.97E-02	1.91E-02	1.1863E+01	5.9246E+02
α_3	4.79E-03	1.06E-02	1.01E-02	1.82E-02	1.08E-02	6.4063E+00	5.9792E+02
α_4	7.45E-04	3.68E-03	3.15E-03	8.43E-03	3.60E-03	2.2255E+00	6.0210E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9587190	0.9694170	0.9698090	0.9787650	0.9701260	7.6581E+02	2.4160E+01
α_2	7.93E-03	1.40E-02	1.36E-02	2.15E-02	1.30E-02	1.1091E+01	7.7888E+02
α_3	4.67E-03	9.59E-03	9.18E-03	1.59E-02	9.56E-03	7.5733E+00	7.8240E+02
α_4	2.05E-03	5.60E-03	5.19E-03	1.06E-02	5.86E-03	4.4226E+00	7.8555E+02
α_5	8.26E-05	1.36E-03	9.68E-04	3.97E-03	1.45E-03	1.0727E+00	7.8890E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9623400	0.9717360	0.9720720	0.9799940	0.9727710	9.1834E+02	2.6710E+01
α_2	5.98E-03	1.09E-02	1.05E-02	1.70E-02	9.76E-03	1.0282E+01	9.3477E+02
α_3	3.94E-03	8.06E-03	7.72E-03	1.34E-02	7.86E-03	7.6196E+00	9.3743E+02
α_4	2.36E-03	5.71E-03	5.37E-03	1.02E-02	5.83E-03	5.3974E+00	9.3965E+02
α_5	7.75E-04	2.99E-03	2.65E-03	6.38E-03	3.16E-03	2.8281E+00	9.4222E+02
α_6	5.14E-06	6.17E-04	3.18E-04	2.24E-03	6.07E-04	5.8334E-01	9.4447E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9697590	0.9658560	0.9664950	0.9701260	0.9727710
α_2	3.02E-02	2.40E-02	1.91E-02	1.30E-02	9.76E-03
α_3		1.01E-02	1.08E-02	9.56E-03	7.86E-03
α_4			3.60E-03	5.86E-03	5.83E-03
α_5				1.45E-03	3.16E-03
α_6					6.07E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.70E-01	9.66E-01	9.66E-01	9.70E-01	9.73E-01
Beta	3.02E-02	3.41E-02	3.35E-02	2.99E-02	2.72E-02
Gamma		2.97E-01	4.29E-01	5.65E-01	6.41E-01
Delta			2.50E-01	4.34E-01	5.50E-01
Epsilon				1.98E-01	3.93E-01
Mu					1.61E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	263.55	395.33	527.10	658.88	790.65
N_1	13.8740	12.1795	10.5936	10.7657	10.7462
N_2	8.6513	10.1316	10.6351	8.9764	8.0427
N_3		4.2742	6.0020	6.5959	6.4778
N_4			2.0028	4.0482	4.8052
N_5				1.0004	2.6059
N_6					0.5001

1.1.2 Pooled Pump Volutes

1.1.2.1 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 Fail to Run less than 1 Hour
Subcomponent :	Pump
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 93.50
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9561580	0.9812630	0.9841340	0.9965600	0.9836570	1.0655E+02	2.0345E+00
α_2	3.44E-03	1.87E-02	1.59E-02	4.38E-02	1.63E-02	2.0345E+00	1.0655E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9613840	0.9808310	0.9826170	0.9941700	0.9843520	1.7299E+02	3.3809E+00
α_2	2.89E-03	1.33E-02	1.16E-02	2.99E-02	1.04E-02	2.3537E+00	1.7402E+02
α_3	3.21E-04	5.82E-03	4.09E-03	1.72E-02	5.22E-03	1.0272E+00	1.7534E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9637160	0.9803030	0.9816130	0.9924100	0.9850090	2.3655E+02	4.7531E+00
α_2	2.81E-03	1.12E-02	9.93E-03	2.42E-02	7.69E-03	2.7141E+00	2.3859E+02
α_3	6.57E-04	5.97E-03	4.67E-03	1.57E-02	5.36E-03	1.4403E+00	2.3986E+02
α_4	2.32E-05	2.48E-03	1.31E-03	8.92E-03	1.95E-03	5.9867E-01	2.4070E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9836570	0.9843520	0.9850090
α_2	1.63E-02	1.04E-02	7.69E-03
α_3		5.22E-03	5.36E-03
α_4			1.95E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.84E-01	9.84E-01	9.85E-01
Beta	1.63E-02	1.56E-02	1.50E-02
Gamma		3.33E-01	4.87E-01
Delta			2.66E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	93.50	140.25	187.00
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

1.1.3 Pooled Clean System Motor Driven Pump Distributions

1.1.3.1 CLEAN SYSTEM MOTOR DRIVEN PUMPS FAIL TO RUN 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 Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 230.60
Total Number of Common-Cause Failure Events: 11

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9501720	0.9723860	0.9740710	0.9888460	0.9731850	1.8023E+02	5.1182E+00
α_2	1.12E-02	2.76E-02	2.59E-02	4.98E-02	2.68E-02	5.1182E+00	1.8023E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9520280	0.9701200	0.9711970	0.9845260	0.9708360	2.8025E+02	8.6319E+00
α_2	9.36E-03	2.11E-02	2.00E-02	3.67E-02	2.04E-02	6.1047E+00	2.8278E+02
α_3	2.04E-03	8.75E-03	7.64E-03	1.92E-02	8.75E-03	2.5272E+00	2.8635E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9569570	0.9719430	0.9727510	0.9841870	0.9734330	3.7835E+02	1.0922E+01
α_2	6.69E-03	1.53E-02	1.45E-02	2.68E-02	1.39E-02	5.9661E+00	3.8331E+02
α_3	2.95E-03	9.27E-03	8.44E-03	1.84E-02	9.38E-03	3.6070E+00	3.8566E+02
α_4	3.39E-04	3.46E-03	2.66E-03	9.34E-03	3.30E-03	1.3487E+00	3.8792E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9620040	0.9742990	0.9749030	0.9845460	0.9766000	5.1036E+02	1.3463E+01
α_2	4.95E-03	1.14E-02	1.07E-02	1.99E-02	9.05E-03	5.9530E+00	5.1787E+02
α_3	3.04E-03	8.36E-03	7.74E-03	1.58E-02	8.02E-03	4.3779E+00	5.1944E+02
α_4	1.09E-03	4.77E-03	4.15E-03	1.05E-02	5.00E-03	2.4970E+00	5.2133E+02
α_5	1.45E-05	1.21E-03	6.64E-04	4.27E-03	1.33E-03	6.3488E-01	5.2319E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9653440	0.9761380	0.9766390	0.9852180	0.9788730	6.1304E+02	1.4986E+01
α_2	3.78E-03	8.95E-03	8.43E-03	1.59E-02	6.67E-03	5.6206E+00	6.2241E+02
α_3	2.41E-03	6.76E-03	6.24E-03	1.29E-02	6.12E-03	4.2444E+00	6.2378E+02
α_4	1.47E-03	5.10E-03	4.58E-03	1.05E-02	5.15E-03	3.2027E+00	6.2482E+02
α_5	3.08E-04	2.47E-03	1.97E-03	6.36E-03	2.63E-03	1.5538E+00	6.2647E+02
α_6	3.12E-07	5.80E-04	1.88E-04	2.49E-03	5.55E-04	3.6454E-01	6.2766E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9731850	0.9708360	0.9734330	0.9766000	0.9788730
α_2	2.68E-02	2.04E-02	1.39E-02	9.05E-03	6.67E-03
α_3		8.75E-03	9.38E-03	8.02E-03	6.12E-03
α_4			3.30E-03	5.00E-03	5.15E-03
α_5				1.33E-03	2.63E-03
α_6					5.55E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.73E-01	9.71E-01	9.73E-01	9.77E-01	9.79E-01
Beta	2.68E-02	2.92E-02	2.66E-02	2.34E-02	2.11E-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	163.55	245.32	327.09	408.87	490.64
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

1.1.3.2 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 :	2009/12/31

Total Number of Independent Failure Events: 364.50
Total Number of Common-Cause Failure Events: 14

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9580120	0.9745110	0.9755580	0.9874440	0.9750700	2.9303E+02	7.6645E+00
α_2	1.26E-02	2.55E-02	2.44E-02	4.20E-02	2.49E-02	7.6645E+00	2.9303E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9654940	0.9778190	0.9785100	0.9877930	0.9787970	4.5087E+02	1.0228E+01
α_2	5.24E-03	1.23E-02	1.16E-02	2.18E-02	1.13E-02	5.6787E+00	4.5542E+02
α_3	3.69E-03	9.87E-03	9.17E-03	1.84E-02	9.95E-03	4.5489E+00	4.5655E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9679760	0.9783860	0.9789030	0.9870420	0.9798210	6.0472E+02	1.3359E+01
α_2	5.32E-03	1.13E-02	1.08E-02	1.91E-02	1.01E-02	6.9894E+00	6.1109E+02
α_3	2.23E-03	6.50E-03	5.97E-03	1.26E-02	6.34E-03	4.0167E+00	6.1406E+02
α_4	8.20E-04	3.81E-03	3.29E-03	8.57E-03	3.74E-03	2.3530E+00	6.1573E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9717650	0.9803920	0.9807840	0.9876770	0.9826230	7.9337E+02	1.5868E+01
α_2	3.80E-03	8.26E-03	7.86E-03	1.41E-02	6.44E-03	6.6839E+00	8.0255E+02
α_3	2.32E-03	5.98E-03	5.58E-03	1.10E-02	5.44E-03	4.8384E+00	8.0440E+02
α_4	1.15E-03	3.97E-03	3.57E-03	8.15E-03	4.00E-03	3.2099E+00	8.0603E+02
α_5	9.70E-05	1.40E-03	1.02E-03	4.02E-03	1.50E-03	1.1357E+00	8.0810E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9745530	0.9820770	0.9824050	0.9884700	0.9845580	9.5265E+02	1.7386E+01
α_2	2.81E-03	6.35E-03	6.01E-03	1.10E-02	4.62E-03	6.1598E+00	9.6388E+02
α_3	1.87E-03	4.89E-03	4.56E-03	9.06E-03	4.24E-03	4.7449E+00	9.6529E+02
α_4	1.24E-03	3.82E-03	3.48E-03	7.54E-03	3.66E-03	3.7019E+00	9.6633E+02
α_5	4.37E-04	2.23E-03	1.90E-03	5.16E-03	2.29E-03	2.1645E+00	9.6787E+02
α_6	6.61E-06	6.34E-04	3.39E-04	2.26E-03	6.26E-04	6.1464E-01	9.6942E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9750700	0.9787970	0.9798210	0.9826230	0.9845580
α_2	2.49E-02	1.13E-02	1.01E-02	6.44E-03	4.62E-03
α_3		9.95E-03	6.34E-03	5.44E-03	4.24E-03
α_4			3.74E-03	4.00E-03	3.66E-03
α_5				1.50E-03	2.29E-03
α_6					6.26E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.75E-01	9.79E-01	9.80E-01	9.83E-01	9.85E-01
Beta	2.49E-02	2.12E-02	2.02E-02	1.74E-02	1.54E-02
Gamma		4.69E-01	4.99E-01	6.29E-01	7.01E-01
Delta			3.71E-01	5.02E-01	6.08E-01
Epsilon				2.73E-01	4.43E-01
Mu					2.15E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	276.14	414.20	552.27	690.34	828.41
N_1	6.6400	7.1150	6.3171	6.8643	7.3041
N_2	7.2300	4.8450	5.7613	4.5697	3.9206
N_3		4.2817	3.6124	3.8610	3.6031
N_4			2.1303	2.8355	3.1097
N_5				1.0634	1.9423
N_6					0.5314

1.1.4 PWR Containment Spray Pumps

1.1.4.1 CONTAINMENT SPRAY MDP-FS

System :	Containment spray recirculation
Component :	Motor Driven Pump
Failure Mode :	Fail to start
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 27.00
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8709140	0.9403200	0.9472680	0.9859180	0.9337640	3.9146E+01	2.4845E+00
α_2	1.41E-02	5.97E-02	5.27E-02	1.29E-01	6.62E-02	2.4845E+00	3.9146E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	0.9337640
α_2	6.62E-02

MGL Parameter	CCCG=2
1-Beta	9.34E-01
Beta	6.62E-02

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	27.00
N_1	1.9000
N_2	2.0500

1.1.4.2 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 :	2009/12/31

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

1.1.4.3 CONTAINMENT SPRAY >1H MDP-FR

System : Containment spray recirculation
Component : Motor Driven Pump
Failure Mode : Fail to run
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 7.20
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9028690	0.9756990	0.9899910	0.9999520	1.0000000	1.7446E+01	4.3452E-01
α_2	4.47E-05	2.43E-02	1.00E-02	9.71E-02	0.00E+00	4.3452E-01	1.7446E+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	7.20
N_1	0.0000
N_2	0.0000

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

System : Containment spray recirculation
Component : Motor Driven Pump
Failure Mode : Fail to run
Fail to Run less than 1 Hour
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 14.20
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9299850	0.9825360	0.9928840	0.9999650	1.0000000	2.4446E+01	4.3452E-01
α_2	3.18E-05	1.75E-02	7.12E-03	7.00E-02	0.00E+00	4.3452E-01	2.4446E+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	14.20
N_1	0.0000
N_2	0.0000

1.1.5 BWR Residual Heat Removal Pumps

1.1.5.1 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
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 :	2009/12/31

Total Number of Independent Failure Events: 6.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8989610	0.9747090	0.9895680	0.9999500	1.0000000	1.6746E+01	4.3452E-01
α_2	4.66E-05	2.53E-02	1.04E-02	1.01E-01	0.00E+00	4.3452E-01	1.6746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9154810	0.9703710	0.9783290	0.9980400	1.0000000	3.6055E+01	1.1009E+00
α_2	7.15E-04	2.24E-02	1.46E-02	7.09E-02	0.00E+00	8.3366E-01	3.6322E+01
α_3	2.53E-07	7.19E-03	1.45E-03	3.41E-02	0.00E+00	2.6722E-01	3.6889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9185670	0.9659560	0.9714920	0.9943870	1.0000000	5.2636E+01	1.8551E+00
α_2	1.87E-03	2.25E-02	1.70E-02	6.21E-02	0.00E+00	1.2281E+00	5.3263E+01
α_3	8.37E-06	7.42E-03	2.76E-03	3.06E-02	0.00E+00	4.0431E-01	5.4087E+01
α_4	1.77E-08	4.09E-03	5.60E-04	2.05E-02	0.00E+00	2.2267E-01	5.4268E+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	6.50	6.50	6.50
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

1.1.5.2 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 : 2009/12/31

Total Number of Independent Failure Events: 29.00
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9072350	0.9714000	0.9820270	0.9992880	0.9793830	2.6079E+01	7.6782E-01
α_2	7.09E-04	2.86E-02	1.80E-02	9.28E-02	2.06E-02	7.6782E-01	2.6079E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9113340	0.9613840	0.9669040	0.9925270	0.9578950	5.2305E+01	2.1009E+00
α_2	5.47E-03	3.37E-02	2.82E-02	8.09E-02	4.21E-02	1.8337E+00	5.2572E+01
α_3	1.72E-07	4.91E-03	9.88E-04	2.33E-02	0.00E+00	2.6722E-01	5.4139E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9061160	0.9511960	0.9549680	0.9833790	0.9354840	7.5136E+01	3.8551E+00
α_2	1.21E-02	4.09E-02	3.70E-02	8.27E-02	6.45E-02	3.2281E+00	7.5763E+01
α_3	5.75E-06	5.12E-03	1.89E-03	2.12E-02	0.00E+00	4.0431E-01	7.8587E+01
α_4	1.21E-08	2.82E-03	3.85E-04	1.41E-02	0.00E+00	2.2267E-01	7.8768E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9793830	0.9578950	0.9354840
α_2	2.06E-02	4.21E-02	6.45E-02
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.79E-01	9.58E-01	9.35E-01
Beta	2.06E-02	4.21E-02	6.45E-02
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	14.50	21.75	29.00
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

1.1.5.3 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 : 2009/12/31

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

1.1.5.4 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 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 :	2009/12/31

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

1.1.6 AFW Motor-Driven Pumps

1.1.6.1 AFW MOTOR DRIVEN PUMP FAIL TO RUN >1H SPAR: AFW-MDP-FR

System :	Auxiliary feedwater
Component :	Motor Driven Pump
Failure Mode :	Fail to run
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 10.70
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9148040	0.9770400	0.9886290	0.9998640	0.9920630	2.2746E+01	5.3452E-01
α_2	1.31E-04	2.30E-02	1.14E-02	8.52E-02	7.94E-03	5.3452E-01	2.2746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9261640	0.9720550	0.9781480	0.9970940	0.9850750	4.8035E+01	1.3809E+00
α_2	1.48E-03	2.23E-02	1.63E-02	6.39E-02	1.44E-02	1.1037E+00	4.8312E+01
α_3	2.86E-07	5.61E-03	1.21E-03	2.63E-02	5.33E-04	2.7722E-01	4.9139E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9276090	0.9673480	0.9715320	0.9927630	0.9789440	7.0452E+01	2.3781E+00
α_2	3.45E-03	2.35E-02	1.93E-02	5.80E-02	1.96E-02	1.7141E+00	7.1116E+01
α_3	1.17E-05	6.05E-03	2.46E-03	2.42E-02	1.45E-03	4.4031E-01	7.2390E+01
α_4	1.40E-08	3.07E-03	4.24E-04	1.54E-02	4.03E-05	2.2367E-01	7.2606E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9920630	0.9850750	0.9789440
α_2	7.94E-03	1.44E-02	1.96E-02
α_3		5.33E-04	1.45E-03
α_4			4.03E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.92E-01	9.85E-01	9.79E-01
Beta	7.94E-03	1.49E-02	2.11E-02
Gamma		3.57E-02	7.07E-02
Delta			2.70E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	10.70	16.05	21.40
N_1	1.8000	2.4300	2.9160
N_2	0.1000	0.2700	0.4860
N_3		0.0100	0.0360
N_4			0.0010

1.1.6.2 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 : 2009/12/31

Total Number of Independent Failure Events: 32.70
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9367870	0.9791780	0.9857590	0.9990810	0.9853800	4.3946E+01	9.3452E-01
α_2	9.16E-04	2.08E-02	1.42E-02	6.32E-02	1.46E-02	9.3452E-01	4.3946E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9404360	0.9742080	0.9779890	0.9950520	0.9803150	7.9355E+01	2.1009E+00
α_2	2.53E-03	1.94E-02	1.57E-02	4.93E-02	1.48E-02	1.5837E+00	7.9872E+01
α_3	3.00E-05	6.35E-03	3.00E-03	2.40E-02	4.92E-03	5.1722E-01	8.0939E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9430200	0.9719780	0.9746670	0.9917490	0.9795620	1.1204E+02	3.2301E+00
α_2	3.04E-03	1.72E-02	1.45E-02	4.05E-02	1.11E-02	1.9781E+00	1.1329E+02
α_3	3.11E-04	7.85E-03	5.24E-03	2.43E-02	7.43E-03	9.0431E-01	1.1437E+02
α_4	1.14E-06	3.02E-03	9.22E-04	1.31E-02	1.86E-03	3.4767E-01	1.1492E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9853800	0.9803150	0.9795620
α_2	1.46E-02	1.48E-02	1.11E-02
α_3		4.92E-03	7.43E-03
α_4			1.86E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.85E-01	9.80E-01	9.80E-01
Beta	1.46E-02	1.97E-02	2.04E-02
Gamma		2.50E-01	4.55E-01
Delta			2.00E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	32.70	49.05	65.40
N_1	1.0000	0.7500	0.5000
N_2	0.5000	0.7500	0.7500
N_3		0.2500	0.5000
N_4			0.1250

1.1.6.3 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 : 2009/12/31

Total Number of Independent Failure Events: 4.50
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8464560	0.9563200	0.9758650	0.9995580	0.9459360	1.3163E+01	6.0122E-01
α_2	4.40E-04	4.37E-02	2.41E-02	1.54E-01	5.41E-02	6.0122E-01	1.3163E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8860440	0.9543060	0.9626900	0.9938400	0.8858450	3.3435E+01	1.6009E+00
α_2	3.75E-03	3.81E-02	2.96E-02	1.01E-01	1.14E-01	1.3337E+00	3.3702E+01
α_3	2.68E-07	7.63E-03	1.54E-03	3.62E-02	0.00E+00	2.6722E-01	3.4769E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8887760	0.9466250	0.9521160	0.9856650	0.8181820	5.0636E+01	2.8551E+00
α_2	8.65E-03	4.17E-02	3.61E-02	9.38E-02	1.82E-01	2.2281E+00	5.1263E+01
α_3	8.53E-06	7.56E-03	2.81E-03	3.12E-02	0.00E+00	4.0431E-01	5.3087E+01
α_4	1.80E-08	4.16E-03	5.71E-04	2.09E-02	0.00E+00	2.2267E-01	5.3268E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9459360	0.8858450	0.8181820
α_2	5.41E-02	1.14E-01	1.82E-01
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.46E-01	8.86E-01	8.18E-01
Beta	5.41E-02	1.14E-01	1.82E-01
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	2.25	3.38	4.50
N_1	0.6667	0.5000	0.0000
N_2	0.1667	0.5000	1.0000
N_3		0.0000	0.0000
N_4			0.0000

1.1.6.4 AFW MOTOR DRIVEN PUMP FAIL TO RUN

System : Auxiliary feedwater
Component : Motor Driven Pump
Failure Mode : Fail to run
Fail to Run less than 1 Hour
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 15.20
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9002390	0.9702170	0.9821610	0.9994570	0.9792670	2.2843E+01	7.0122E-01
α_2	5.40E-04	2.98E-02	1.78E-02	9.98E-02	2.07E-02	7.0122E-01	2.2843E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9097840	0.9620520	0.9681020	0.9936090	0.9587520	4.7685E+01	1.8809E+00
α_2	4.33E-03	3.24E-02	2.63E-02	8.12E-02	4.07E-02	1.6037E+00	4.7962E+01
α_3	2.85E-07	5.59E-03	1.21E-03	2.62E-02	5.29E-04	2.7722E-01	4.9289E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9073350	0.9535340	0.9576410	0.9856740	0.9383630	6.9322E+01	3.3781E+00
α_2	9.48E-03	3.73E-02	3.32E-02	7.95E-02	6.01E-02	2.7141E+00	6.9986E+01
α_3	1.17E-05	6.06E-03	2.46E-03	2.43E-02	1.46E-03	4.4031E-01	7.2260E+01
α_4	1.40E-08	3.08E-03	4.25E-04	1.54E-02	4.05E-05	2.2367E-01	7.2476E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9792670	0.9587520	0.9383630
α_2	2.07E-02	4.07E-02	6.01E-02
α_3		5.29E-04	1.46E-03
α_4			4.05E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.79E-01	9.59E-01	9.38E-01
Beta	2.07E-02	4.12E-02	6.16E-02
Gamma		1.28E-02	2.43E-02
Delta			2.70E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	10.13	15.20	20.27
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

1.1.7 AFW Pump Volutes

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

System :	Auxiliary feedwater
Component :	Motor Driven Pump Turbine Driven Pump
Failure Mode :	Fail to run Fail to Run less than 1 Hour
Subcomponent :	Pump
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 18.60
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9362050	0.9828570	0.9915700	0.9999050	0.9951220	3.0646E+01	5.3452E-01
α_2	9.71E-05	1.71E-02	8.43E-03	6.38E-02	4.88E-03	5.3452E-01	3.0646E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9402880	0.9774600	0.9824210	0.9976660	0.9908530	5.9885E+01	1.3809E+00
α_2	1.19E-03	1.80E-02	1.31E-02	5.17E-02	8.82E-03	1.1037E+00	6.0162E+01
α_3	2.30E-07	4.52E-03	9.73E-04	2.12E-02	3.27E-04	2.7722E-01	6.0989E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9403620	0.9731680	0.9766490	0.9940690	0.9871310	8.6252E+01	2.3781E+00
α_2	2.83E-03	1.93E-02	1.59E-02	4.78E-02	1.20E-02	1.7141E+00	8.6916E+01
α_3	9.59E-06	4.97E-03	2.02E-03	1.99E-02	8.86E-04	4.4031E-01	8.8190E+01
α_4	1.15E-08	2.52E-03	3.48E-04	1.26E-02	2.46E-05	2.2367E-01	8.8406E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9951220	0.9908530	0.9871310
α_2	4.88E-03	8.82E-03	1.20E-02
α_3		3.27E-04	8.86E-04
α_4			2.46E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.95E-01	9.91E-01	9.87E-01
Beta	4.88E-03	9.15E-03	1.29E-02
Gamma		3.57E-02	7.07E-02
Delta			2.70E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	18.60	27.90	37.20
N_1	1.8000	2.4300	2.9160
N_2	0.1000	0.2700	0.4860
N_3		0.0100	0.0360
N_4			0.0010

1.1.8 Emergency Service Water Pump

1.1.8.1 NORMALLY RUNNING SERVICE WATER MDP FAIL TO RUN

System :	Normally operating service water
Component :	Motor Driven Pump
Failure Mode :	Fail to run
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 96.20
Total Number of Common-Cause Failure Events: 5

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9282020	0.9709400	0.9761610	0.9958060	0.9735560	5.6449E+01	1.6895E+00
α_2	4.19E-03	2.91E-02	2.38E-02	7.18E-02	2.64E-02	1.6895E+00	5.6449E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9405340	0.9717670	0.9748280	0.9925370	0.9751150	9.8113E+01	2.8505E+00
α_2	2.00E-03	1.56E-02	1.25E-02	3.97E-02	1.06E-02	1.5755E+00	9.9388E+01
α_3	1.12E-03	1.26E-02	9.59E-03	3.45E-02	1.43E-02	1.2750E+00	9.9688E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9447950	0.9710890	0.9732920	0.9898610	0.9761180	1.3691E+02	4.0761E+00
α_2	3.44E-03	1.63E-02	1.41E-02	3.67E-02	1.15E-02	2.2961E+00	1.3869E+02
α_3	4.42E-04	7.49E-03	5.33E-03	2.19E-02	7.01E-03	1.0563E+00	1.3993E+02
α_4	1.01E-04	5.13E-03	3.06E-03	1.72E-02	5.39E-03	7.2367E-01	1.4026E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9499370	0.9708930	0.9723370	0.9869090	0.9763980	2.0901E+02	6.2661E+00
α_2	5.05E-03	1.62E-02	1.47E-02	3.24E-02	1.19E-02	3.4915E+00	2.1178E+02
α_3	8.82E-04	7.16E-03	5.70E-03	1.84E-02	4.88E-03	1.5410E+00	2.1374E+02
α_4	1.71E-04	4.23E-03	2.83E-03	1.31E-02	4.64E-03	9.1109E-01	2.1436E+02
α_5	3.04E-07	1.50E-03	4.10E-04	6.69E-03	2.16E-03	3.2248E-01	2.1495E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9519930	0.9709340	0.9721350	0.9857690	0.9764050	2.5172E+02	7.5355E+00
α_2	5.11E-03	1.51E-02	1.39E-02	2.93E-02	1.21E-02	3.9110E+00	2.5534E+02
α_3	9.96E-04	6.72E-03	5.50E-03	1.66E-02	4.35E-03	1.7418E+00	2.5751E+02
α_4	2.49E-04	4.12E-03	2.94E-03	1.20E-02	3.45E-03	1.0684E+00	2.5819E+02
α_5	2.30E-05	2.34E-03	1.24E-03	8.37E-03	2.78E-03	6.0610E-01	2.5865E+02
α_6	1.43E-09	8.03E-04	9.28E-05	4.10E-03	9.06E-04	2.0824E-01	2.5905E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9735560	0.9751150	0.9761180	0.9763980	0.9764050
α_2	2.64E-02	1.06E-02	1.15E-02	1.19E-02	1.21E-02
α_3		1.43E-02	7.01E-03	4.88E-03	4.35E-03
α_4			5.39E-03	4.64E-03	3.45E-03
α_5				2.16E-03	2.78E-03
α_6					9.06E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.74E-01	9.75E-01	9.76E-01	9.76E-01	9.76E-01
Beta	2.64E-02	2.49E-02	2.39E-02	2.36E-02	2.36E-02
Gamma		5.76E-01	5.19E-01	4.95E-01	4.87E-01
Delta			4.35E-01	5.83E-01	6.21E-01
Epsilon				3.18E-01	5.17E-01
Mu					2.46E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	43.73	65.59	87.45	109.32	131.18
N_1	2.4733	2.9683	3.3290	3.5279	3.5985
N_2	1.2550	0.7418	1.0680	1.3773	1.6718
N_3		1.0078	0.6520	0.5636	0.6000
N_4			0.5010	0.5367	0.4762
N_5				0.2502	0.3839
N_6					0.1250

1.1.8.2 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 : 2009/12/31

Total Number of Independent Failure Events: 67.60
Total Number of Common-Cause Failure Events: 5

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9474230	0.9825890	0.9880190	0.9991930	0.9882290	5.3802E+01	9.5332E-01
α_2	8.04E-04	1.74E-02	1.20E-02	5.26E-02	1.18E-02	9.5332E-01	5.3802E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9444980	0.9749570	0.9781790	0.9944040	0.9800470	9.3717E+01	2.4072E+00
α_2	3.81E-03	2.10E-02	1.77E-02	4.91E-02	1.80E-02	2.0150E+00	9.4109E+01
α_3	3.73E-06	4.08E-03	1.46E-03	1.70E-02	1.91E-03	3.9222E-01	9.5732E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9413690	0.9691280	0.9714240	0.9890260	0.9734450	1.3036E+02	4.1527E+00
α_2	6.99E-03	2.39E-02	2.16E-02	4.87E-02	2.29E-02	3.2119E+00	1.3130E+02
α_3	6.65E-05	4.87E-03	2.74E-03	1.69E-02	2.90E-03	6.5561E-01	1.3386E+02
α_4	1.41E-07	2.12E-03	4.77E-04	9.85E-03	7.22E-04	2.8517E-01	1.3423E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9484360	0.9700880	0.9715870	0.9866160	0.9752610	2.0099E+02	6.1974E+00
α_2	6.24E-03	1.86E-02	1.71E-02	3.62E-02	1.62E-02	3.8528E+00	2.0333E+02
α_3	1.19E-03	8.25E-03	6.73E-03	2.05E-02	6.82E-03	1.7103E+00	2.0548E+02
α_4	1.37E-05	2.56E-03	1.23E-03	9.62E-03	1.45E-03	5.3069E-01	2.0666E+02
α_5	8.10E-16	5.00E-04	3.66E-06	2.90E-03	2.91E-04	1.0358E-01	2.0708E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9515000	0.9708550	0.9721020	0.9859480	0.9766630	2.4233E+02	7.2748E+00
α_2	5.13E-03	1.54E-02	1.41E-02	3.00E-02	1.24E-02	3.8351E+00	2.4577E+02
α_3	1.55E-03	8.31E-03	7.03E-03	1.94E-02	7.25E-03	2.0731E+00	2.4753E+02
α_4	1.73E-04	3.81E-03	2.60E-03	1.16E-02	2.80E-03	9.5172E-01	2.4865E+02
α_5	2.16E-07	1.27E-03	3.36E-04	5.69E-03	7.31E-04	3.1600E-01	2.4929E+02
α_6	1.67E-16	3.96E-04	2.19E-06	2.30E-03	1.22E-04	9.8837E-02	2.4951E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9882290	0.9800470	0.9734450	0.9752610	0.9766630
α_2	1.18E-02	1.80E-02	2.29E-02	1.62E-02	1.24E-02
α_3		1.91E-03	2.90E-03	6.82E-03	7.25E-03
α_4			7.22E-04	1.45E-03	2.80E-03
α_5				2.91E-04	7.31E-04
α_6					1.22E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.88E-01	9.80E-01	9.73E-01	9.75E-01	9.77E-01
Beta	1.18E-02	2.00E-02	2.66E-02	2.47E-02	2.33E-02
Gamma		9.57E-02	1.37E-01	3.46E-01	4.67E-01
Delta			1.99E-01	2.04E-01	3.35E-01
Epsilon				1.67E-01	2.33E-01
Mu					1.43E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	39.76	59.65	79.53	99.41	119.29
N_1	3.7958	4.5125	4.6950	5.4168	6.0957
N_2	0.5188	1.1813	1.9838	1.7386	1.5959
N_3		0.1250	0.2513	0.7329	0.9313
N_4			0.0625	0.1563	0.3595
N_5				0.0313	0.0938
N_6					0.0156

1.1.8.3 STANDBY SERVICE WATER MDP FAIL TO RUN

System : Standby service water
Component : Motor Driven Pump
Failure Mode : Fail to run
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 38.60
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8904930	0.9589700	0.9681340	0.9960600	0.9587970	3.0707E+01	1.3138E+00
α_2	3.94E-03	4.10E-02	3.19E-02	1.10E-01	4.12E-02	1.3138E+00	3.0707E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8944970	0.9476400	0.9524300	0.9843920	0.9313530	5.8388E+01	3.2261E+00
α_2	1.11E-02	4.39E-02	3.90E-02	9.32E-02	6.04E-02	2.7025E+00	5.8912E+01
α_3	4.29E-05	8.50E-03	4.07E-03	3.20E-02	8.28E-03	5.2362E-01	6.1090E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8968450	0.9423710	0.9456960	0.9765290	0.9197190	8.3107E+01	5.0823E+00
α_2	1.21E-02	3.89E-02	3.55E-02	7.75E-02	5.48E-02	3.4322E+00	8.4757E+01
α_3	1.77E-03	1.62E-02	1.27E-02	4.25E-02	2.54E-02	1.4266E+00	8.6763E+01
α_4	1.14E-08	2.53E-03	3.49E-04	1.27E-02	1.99E-05	2.2347E-01	8.7966E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9226360	0.9538460	0.9558670	0.9781610	0.9323230	1.4223E+02	6.8822E+00
α_2	8.26E-03	2.51E-02	2.30E-02	4.91E-02	3.29E-02	3.7391E+00	1.4537E+02
α_3	2.48E-03	1.36E-02	1.15E-02	3.19E-02	2.12E-02	2.0260E+00	1.4709E+02
α_4	4.02E-04	7.01E-03	4.96E-03	2.06E-02	1.36E-02	1.0447E+00	1.4807E+02
α_5	4.23E-21	4.85E-04	2.77E-07	2.81E-03	2.02E-06	7.2377E-02	1.4904E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9296400	0.9570110	0.9586990	0.9786190	0.9410970	1.7209E+02	7.7303E+00
α_2	6.02E-03	1.94E-02	1.76E-02	3.87E-02	2.12E-02	3.4796E+00	1.7634E+02
α_3	2.53E-03	1.24E-02	1.06E-02	2.83E-02	1.86E-02	2.2303E+00	1.7759E+02
α_4	6.18E-04	7.06E-03	5.34E-03	1.94E-02	1.16E-02	1.2699E+00	1.7855E+02
α_5	5.41E-05	3.71E-03	2.10E-03	1.28E-02	7.60E-03	6.6730E-01	1.7915E+02
α_6	7.83E-19	4.63E-04	8.09E-07	2.70E-03	0.00E+00	8.3237E-02	1.7974E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9587970	0.9313530	0.9197190	0.9323230	0.9410970
α_2	4.12E-02	6.04E-02	5.48E-02	3.29E-02	2.12E-02
α_3		8.28E-03	2.54E-02	2.12E-02	1.86E-02
α_4			1.99E-05	1.36E-02	1.16E-02
α_5				2.02E-06	7.60E-03
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.59E-01	9.31E-01	9.20E-01	9.32E-01	9.41E-01
Beta	4.12E-02	6.86E-02	8.03E-02	6.77E-02	5.89E-02
Gamma		1.21E-01	3.17E-01	5.14E-01	6.41E-01
Delta			7.82E-04	3.90E-01	5.08E-01
Epsilon				1.49E-04	3.96E-01
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	18.16	27.25	36.33	45.41	54.49
N_1	2.3013	1.5832	0.6415	0.6561	0.6580
N_2	0.8793	1.8688	2.2041	1.6249	1.2404
N_3		0.2564	1.0223	1.0486	1.0885
N_4			0.0008	0.6703	0.6777
N_5				0.0001	0.4451
N_6					0.0000

1.1.8.4 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 :	2009/12/31

Total Number of Independent Failure Events: 68.20
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9295020	0.9767160	0.9840230	0.9989600	0.9829920	3.9352E+01	9.3812E-01
α_2	1.04E-03	2.33E-02	1.60E-02	7.05E-02	1.70E-02	9.3812E-01	3.9352E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9243000	0.9648580	0.9689530	0.9914150	0.9653980	7.1704E+01	2.6116E+00
α_2	6.88E-03	3.15E-02	2.74E-02	7.03E-02	3.46E-02	2.3444E+00	7.1971E+01
α_3	1.25E-07	3.60E-03	7.21E-04	1.71E-02	0.00E+00	2.6722E-01	7.4048E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9291230	0.9632650	0.9661560	0.9875120	0.9648690	1.0165E+02	3.8765E+00
α_2	6.65E-03	2.61E-02	2.31E-02	5.55E-02	2.64E-02	2.7495E+00	1.0278E+02
α_3	3.40E-04	8.57E-03	5.73E-03	2.65E-02	8.69E-03	9.0431E-01	1.0462E+02
α_4	9.07E-09	2.11E-03	2.88E-04	1.06E-02	0.00E+00	2.2267E-01	1.0530E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9424990	0.9674250	0.9692300	0.9861850	0.9714950	1.6554E+02	5.5740E+00
α_2	5.03E-03	1.79E-02	1.61E-02	3.71E-02	1.33E-02	3.0666E+00	1.6805E+02
α_3	1.66E-03	1.06E-02	8.74E-03	2.58E-02	1.17E-02	1.8107E+00	1.6930E+02
α_4	4.08E-05	3.65E-03	1.98E-03	1.29E-02	3.50E-03	6.2439E-01	1.7049E+02
α_5	3.48E-21	4.22E-04	2.38E-07	2.44E-03	0.00E+00	7.2277E-02	1.7104E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9474090	0.9693360	0.9708380	0.9861240	0.9759220	2.0017E+02	6.3321E+00
α_2	3.65E-03	1.39E-02	1.23E-02	2.93E-02	7.30E-03	2.8622E+00	2.0364E+02
α_3	1.66E-03	9.50E-03	7.97E-03	2.26E-02	9.61E-03	1.9612E+00	2.0454E+02
α_4	3.23E-04	5.22E-03	3.74E-03	1.52E-02	5.70E-03	1.0783E+00	2.0542E+02
α_5	6.25E-07	1.68E-03	5.12E-04	7.33E-03	1.47E-03	3.4720E-01	2.0615E+02
α_6	6.82E-19	4.03E-04	7.04E-07	2.35E-03	0.00E+00	8.3237E-02	2.0642E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9829920	0.9653980	0.9648690	0.9714950	0.9759220
α_2	1.70E-02	3.46E-02	2.64E-02	1.33E-02	7.30E-03
α_3		0.00E+00	8.69E-03	1.17E-02	9.61E-03
α_4			0.00E+00	3.50E-03	5.70E-03
α_5				0.00E+00	1.47E-03
α_6					0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.83E-01	9.65E-01	9.65E-01	9.71E-01	9.76E-01
Beta	1.70E-02	3.46E-02	3.51E-02	2.85E-02	2.41E-02
Gamma		0.00E+00	2.47E-01	5.32E-01	6.97E-01
Delta			0.00E+00	2.31E-01	4.27E-01
Epsilon				0.00E+00	2.05E-01
Mu					0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	27.28	40.92	54.56	68.20	81.84
N_1	1.8262	1.2286	0.9571	1.1786	1.3929
N_2	0.5036	1.5107	1.5214	0.9524	0.6230
N_3		0.0000	0.5000	0.8333	0.8194
N_4			0.0000	0.2500	0.4861
N_5				0.0000	0.1250
N_6					0.0000

1.1.8.5 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
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 134.80
Total Number of Common-Cause Failure Events: 9

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9302750	0.9678300	0.9716560	0.9922770	0.9691440	7.7281E+01	2.5688E+00
α_2	7.72E-03	3.22E-02	2.83E-02	6.97E-02	3.09E-02	2.5688E+00	7.7281E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9319800	0.9624410	0.9647460	0.9850180	0.9619430	1.2750E+02	4.9757E+00
α_2	8.05E-03	2.60E-02	2.36E-02	5.20E-02	2.56E-02	3.4443E+00	1.2903E+02
α_3	1.42E-03	1.16E-02	9.21E-03	2.97E-02	1.24E-02	1.5314E+00	1.3094E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9334560	0.9598600	0.9615330	0.9805360	0.9593260	1.7464E+02	7.3033E+00
α_2	9.24E-03	2.47E-02	2.30E-02	4.61E-02	2.44E-02	4.5002E+00	1.7744E+02
α_3	2.14E-03	1.14E-02	9.69E-03	2.66E-02	1.25E-02	2.0786E+00	1.7986E+02
α_4	7.86E-05	3.98E-03	2.37E-03	1.34E-02	3.75E-03	7.2447E-01	1.8122E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9432340	0.9638210	0.9649780	0.9804540	0.9634050	2.5601E+02	9.6100E+00
α_2	7.75E-03	1.93E-02	1.81E-02	3.49E-02	1.81E-02	5.1165E+00	2.6050E+02
α_3	2.33E-03	9.75E-03	8.55E-03	2.13E-02	9.72E-03	2.5896E+00	2.6303E+02
α_4	7.64E-04	5.95E-03	4.77E-03	1.52E-02	7.27E-03	1.5813E+00	2.6404E+02
α_5	2.47E-07	1.21E-03	3.32E-04	5.42E-03	1.51E-03	3.2258E-01	2.6530E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9472870	0.9655550	0.9665220	0.9805090	0.9660770	3.0799E+02	1.0987E+01
α_2	6.52E-03	1.61E-02	1.51E-02	2.92E-02	1.47E-02	5.1513E+00	3.1383E+02
α_3	2.31E-03	8.87E-03	7.87E-03	1.89E-02	8.54E-03	2.8303E+00	3.1615E+02
α_4	8.14E-04	5.47E-03	4.48E-03	1.35E-02	5.83E-03	1.7460E+00	3.1723E+02
α_5	1.91E-04	3.30E-03	2.33E-03	9.68E-03	4.19E-03	1.0512E+00	3.1793E+02
α_6	1.17E-09	6.53E-04	7.54E-05	3.33E-03	6.32E-04	2.0824E-01	3.1877E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9691440	0.9619430	0.9593260	0.9634050	0.9660770
α_2	3.09E-02	2.56E-02	2.44E-02	1.81E-02	1.47E-02
α_3		1.24E-02	1.25E-02	9.72E-03	8.54E-03
α_4			3.75E-03	7.27E-03	5.83E-03
α_5				1.51E-03	4.19E-03
α_6					6.32E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.69E-01	9.62E-01	9.59E-01	9.63E-01	9.66E-01
Beta	3.09E-02	3.81E-02	4.07E-02	3.66E-02	3.39E-02
Gamma		3.26E-01	3.99E-01	5.06E-01	5.66E-01
Delta			2.31E-01	4.75E-01	5.55E-01
Epsilon				1.72E-01	4.53E-01
Mu					1.31E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	62.26	93.39	124.53	155.66	186.79
N_1	4.7747	4.5515	3.9705	4.1840	4.2564
N_2	2.1343	2.6106	3.2721	3.0023	2.9121
N_3		1.2642	1.6743	1.6122	1.6885
N_4			0.5018	1.2069	1.1538
N_5				0.2503	0.8290
N_6					0.1250

1.1.8.6 SERVICE WATER MDP FAIL TO RUN SPAR:ESW-MDP-FS

System : Normally operating service water
Standby service water
Component : Motor Driven Pump
Failure Mode : Fail to start
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 135.80
Total Number of Common-Cause Failure Events: 8

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9554040	0.9829060	0.9865170	0.9980620	0.9862860	8.3768E+01	1.4568E+00
α_2	1.93E-03	1.71E-02	1.35E-02	4.46E-02	1.37E-02	1.4568E+00	8.3768E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9463910	0.9722270	0.9744320	0.9905270	0.9744860	1.3715E+02	3.9179E+00
α_2	7.88E-03	2.50E-02	2.28E-02	4.97E-02	2.44E-02	3.5257E+00	1.3754E+02
α_3	2.53E-06	2.78E-03	9.90E-04	1.16E-02	1.13E-03	3.9222E-01	1.4068E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9450510	0.9681360	0.9697330	0.9857540	0.9703710	1.8759E+02	6.1741E+00
α_2	9.41E-03	2.44E-02	2.28E-02	4.50E-02	2.40E-02	4.7333E+00	1.8903E+02
α_3	4.30E-04	5.96E-03	4.37E-03	1.69E-02	5.15E-03	1.1556E+00	1.9261E+02
α_4	9.80E-08	1.47E-03	3.30E-04	6.84E-03	4.29E-04	2.8517E-01	1.9348E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9524580	0.9706740	0.9717830	0.9850990	0.9740680	2.7251E+02	8.2331E+00
α_2	6.63E-03	1.71E-02	1.60E-02	3.15E-02	1.49E-02	4.8052E+00	2.7594E+02
α_3	2.12E-03	9.06E-03	7.92E-03	1.99E-02	8.65E-03	2.5436E+00	2.7820E+02
α_4	7.06E-05	2.78E-03	1.72E-03	9.09E-03	2.24E-03	7.8069E-01	2.7996E+02
α_5	5.98E-16	3.69E-04	2.70E-06	2.14E-03	1.73E-04	1.0358E-01	2.8064E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9562830	0.9723570	0.9732830	0.9852590	0.9766480	3.2813E+02	9.3283E+00
α_2	4.88E-03	1.32E-02	1.23E-02	2.48E-02	1.03E-02	4.4581E+00	3.3300E+02
α_3	2.27E-03	8.57E-03	7.62E-03	1.81E-02	8.10E-03	2.8926E+00	3.3457E+02
α_4	4.67E-04	4.26E-03	3.33E-03	1.12E-02	3.91E-03	1.4378E+00	3.3602E+02
α_5	2.53E-06	1.31E-03	5.28E-04	5.25E-03	1.01E-03	4.4100E-01	3.3702E+02
α_6	1.24E-16	2.93E-04	1.62E-06	1.70E-03	7.21E-05	9.8837E-02	3.3736E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9862860	0.9744860	0.9703710	0.9740680	0.9766480
α_2	1.37E-02	2.44E-02	2.40E-02	1.49E-02	1.03E-02
α_3		1.13E-03	5.15E-03	8.65E-03	8.10E-03
α_4			4.29E-04	2.24E-03	3.91E-03
α_5				1.73E-04	1.01E-03
α_6					7.21E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.86E-01	9.74E-01	9.70E-01	9.74E-01	9.77E-01
Beta	1.37E-02	2.55E-02	2.96E-02	2.59E-02	2.34E-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	67.90	101.85	135.80	169.75	203.70
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

1.1.9 PWR High Pressure Safety Injection Pump

1.1.9.1 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
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 112.40
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9532550	0.9798070	0.9827980	0.9961400	0.9821490	1.0197E+02	2.1015E+00
α_2	3.86E-03	2.02E-02	1.72E-02	4.67E-02	1.79E-02	2.1015E+00	1.0197E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9579530	0.9787480	0.9806010	0.9932010	0.9819850	1.6588E+02	3.6019E+00
α_2	3.65E-03	1.53E-02	1.34E-02	3.32E-02	1.26E-02	2.5847E+00	1.6690E+02
α_3	3.23E-04	6.00E-03	4.20E-03	1.78E-02	5.40E-03	1.0172E+00	1.6846E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9614210	0.9788920	0.9802510	0.9917140	0.9834660	2.2718E+02	4.8988E+00
α_2	2.96E-03	1.18E-02	1.04E-02	2.53E-02	8.16E-03	2.7301E+00	2.2935E+02
α_3	8.60E-04	6.77E-03	5.41E-03	1.73E-02	6.34E-03	1.5710E+00	2.3051E+02
α_4	2.39E-05	2.58E-03	1.36E-03	9.27E-03	2.04E-03	5.9767E-01	2.3148E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9821490	0.9819850	0.9834660
α_2	1.79E-02	1.26E-02	8.16E-03
α_3		5.40E-03	6.34E-03
α_4			2.04E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.82E-01	9.82E-01	9.83E-01
Beta	1.79E-02	1.80E-02	1.65E-02
Gamma		3.00E-01	5.07E-01
Delta			2.43E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	89.92	134.88	179.84
N_1	1.7993	1.4480	1.2071
N_2	1.6670	1.7510	1.5020
N_3		0.7500	1.1667
N_4			0.3750

1.1.9.2 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 run
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 112.40
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9532550	0.9798070	0.9827980	0.9961400	0.9821490	1.0197E+02	2.1015E+00
α_2	3.86E-03	2.02E-02	1.72E-02	4.67E-02	1.79E-02	2.1015E+00	1.0197E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9579530	0.9787480	0.9806010	0.9932010	0.9819850	1.6588E+02	3.6019E+00
α_2	3.65E-03	1.53E-02	1.34E-02	3.32E-02	1.26E-02	2.5847E+00	1.6690E+02
α_3	3.23E-04	6.00E-03	4.20E-03	1.78E-02	5.40E-03	1.0172E+00	1.6846E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9614210	0.9788920	0.9802510	0.9917140	0.9834660	2.2718E+02	4.8988E+00
α_2	2.96E-03	1.18E-02	1.04E-02	2.53E-02	8.16E-03	2.7301E+00	2.2935E+02
α_3	8.60E-04	6.77E-03	5.41E-03	1.73E-02	6.34E-03	1.5710E+00	2.3051E+02
α_4	2.39E-05	2.58E-03	1.36E-03	9.27E-03	2.04E-03	5.9767E-01	2.3148E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9821490	0.9819850	0.9834660
α_2	1.79E-02	1.26E-02	8.16E-03
α_3		5.40E-03	6.34E-03
α_4			2.04E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.82E-01	9.82E-01	9.83E-01
Beta	1.79E-02	1.80E-02	1.65E-02
Gamma		3.00E-01	5.07E-01
Delta			2.43E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	89.92	134.88	179.84
N_1	1.7993	1.4480	1.2071
N_2	1.6670	1.7510	1.5020
N_3		0.7500	1.1667
N_4			0.3750

1.1.9.3 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 : 2009/12/31

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	0.8577160	0.9557470	0.9718050	0.9988850	0.9500300	1.6583E+01	7.6782E-01
α_2	1.12E-03	4.43E-02	2.82E-02	1.42E-01	5.00E-02	7.6782E-01	1.6583E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8806230	0.9476810	0.9549650	0.9897820	0.8947370	3.8055E+01	2.1009E+00
α_2	7.48E-03	4.57E-02	3.83E-02	1.09E-01	1.05E-01	1.8337E+00	3.8322E+01
α_3	2.34E-07	6.65E-03	1.34E-03	3.16E-02	0.00E+00	2.6722E-01	3.9889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9011240	0.9526690	0.9576020	0.9873310	0.9188970	5.7466E+01	2.8551E+00
α_2	4.27E-03	2.86E-02	2.36E-02	7.03E-02	4.06E-02	1.7281E+00	5.8593E+01
α_3	5.99E-04	1.50E-02	1.01E-02	4.62E-02	4.06E-02	9.0431E-01	5.9417E+01
α_4	1.59E-08	3.69E-03	5.06E-04	1.85E-02	0.00E+00	2.2267E-01	6.0098E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9500300	0.8947370	0.9188970
α_2	5.00E-02	1.05E-01	4.06E-02
α_3		0.00E+00	4.06E-02
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.50E-01	8.95E-01	9.19E-01
Beta	5.00E-02	1.05E-01	8.11E-02
Gamma		0.00E+00	5.00E-01
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	5.67	8.50	11.33
N_1	0.6667	0.0000	0.0000
N_2	0.3333	1.0000	0.5000
N_3		0.0000	0.5000
N_4			0.0000

1.1.9.4 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 Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 120.90
Total Number of Common-Cause Failure Events: 5

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9502190	0.9774860	0.9803650	0.9949170	0.9794770	1.0571E+02	2.4348E+00
α_2	5.09E-03	2.25E-02	1.96E-02	4.98E-02	2.05E-02	2.4348E+00	1.0571E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9512970	0.9737190	0.9755050	0.9900400	0.9757630	1.7050E+02	4.6019E+00
α_2	6.52E-03	2.05E-02	1.87E-02	4.06E-02	1.90E-02	3.5847E+00	1.7152E+02
α_3	3.13E-04	5.81E-03	4.07E-03	1.72E-02	5.19E-03	1.0172E+00	1.7408E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9569440	0.9753440	0.9766600	0.9892600	0.9788570	2.3334E+02	5.8988E+00
α_2	3.95E-03	1.35E-02	1.22E-02	2.76E-02	1.05E-02	3.2301E+00	2.3601E+02
α_3	1.62E-03	8.66E-03	7.33E-03	2.02E-02	8.71E-03	2.0710E+00	2.3717E+02
α_4	2.32E-05	2.50E-03	1.31E-03	8.99E-03	1.96E-03	5.9767E-01	2.3864E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9794770	0.9757630	0.9788570
α_2	2.05E-02	1.90E-02	1.05E-02
α_3		5.19E-03	8.71E-03
α_4			1.96E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.79E-01	9.76E-01	9.79E-01
Beta	2.05E-02	2.42E-02	2.11E-02
Gamma		2.14E-01	5.05E-01
Delta			1.84E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	93.00	139.50	186.00
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

1.1.10PWR Residual Heat Removal Pump

1.1.10.1 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
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 :	2009/12/31

Total Number of Independent Failure Events: 10.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9163020	0.9790900	0.9914310	0.9999580	1.0000000	2.0346E+01	4.3452E-01
α_2	3.82E-05	2.09E-02	8.57E-03	8.37E-02	0.00E+00	4.3452E-01	2.0346E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9228410	0.9729880	0.9802740	0.9982170	1.0000000	3.9655E+01	1.1009E+00
α_2	6.50E-04	2.05E-02	1.33E-02	6.47E-02	0.00E+00	8.3366E-01	3.9922E+01
α_3	2.30E-07	6.56E-03	1.32E-03	3.11E-02	0.00E+00	2.6722E-01	4.0489E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9235390	0.9680660	0.9732830	0.9947430	1.0000000	5.6236E+01	1.8551E+00
α_2	1.75E-03	2.11E-02	1.59E-02	5.83E-02	0.00E+00	1.2281E+00	5.6863E+01
α_3	7.85E-06	6.96E-03	2.58E-03	2.87E-02	0.00E+00	4.0431E-01	5.7687E+01
α_4	1.66E-08	3.83E-03	5.25E-04	1.92E-02	0.00E+00	2.2267E-01	5.7868E+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	10.10	10.10	10.10
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

1.1.10.2 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 :	2009/12/31

Total Number of Independent Failure Events: 32.50
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9028780	0.9611600	0.9683620	0.9947730	0.9618020	3.9706E+01	1.6045E+00
α_2	5.22E-03	3.88E-02	3.16E-02	9.71E-02	3.82E-02	1.6045E+00	3.9706E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9269580	0.9663310	0.9703470	0.9919590	0.9678510	7.3320E+01	2.5546E+00
α_2	3.53E-03	2.32E-02	1.91E-02	5.67E-02	2.05E-02	1.7592E+00	7.4115E+01
α_3	2.85E-04	1.05E-02	6.61E-03	3.39E-02	1.17E-02	7.9542E-01	7.5079E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9334550	0.9660880	0.9689400	0.9889740	0.9699020	1.0402E+02	3.6514E+00
α_2	4.00E-03	2.02E-02	1.73E-02	4.62E-02	1.58E-02	2.1700E+00	1.0550E+02
α_3	4.87E-04	9.32E-03	6.51E-03	2.78E-02	1.00E-02	1.0036E+00	1.0667E+02
α_4	1.37E-05	4.44E-03	1.95E-03	1.73E-02	4.27E-03	4.7777E-01	1.0719E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9618020	0.9678510	0.9699020
α_2	3.82E-02	2.05E-02	1.58E-02
α_3		1.17E-02	1.00E-02
α_4			4.27E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.62E-01	9.68E-01	9.70E-01
Beta	3.82E-02	3.21E-02	3.01E-02
Gamma		3.63E-01	4.76E-01
Delta			2.99E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	27.90	41.85	55.79
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

1.1.10.3 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 : 2009/12/31

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	0.7180720	0.8868740	0.9070060	0.9864790	0.5000000	1.1246E+01	1.4345E+00
α_2	1.35E-02	1.13E-01	9.30E-02	2.82E-01	5.00E-01	1.4345E+00	1.1246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8561580	0.9366350	0.9452630	0.9875260	0.6000000	3.1055E+01	2.1009E+00
α_2	3.97E-03	4.02E-02	3.14E-02	1.07E-01	2.00E-01	1.3337E+00	3.1822E+01
α_3	5.68E-04	2.31E-02	1.45E-02	7.53E-02	2.00E-01	7.6722E-01	3.2389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8834530	0.9440080	0.9497380	0.9849400	0.6666670	4.8136E+01	2.8551E+00
α_2	3.39E-03	2.90E-02	2.31E-02	7.48E-02	8.33E-02	1.4781E+00	4.9513E+01
α_3	7.11E-04	1.77E-02	1.19E-02	5.46E-02	1.67E-01	9.0431E-01	5.0087E+01
α_4	2.72E-05	9.27E-03	4.06E-03	3.62E-02	8.33E-02	4.7267E-01	5.0518E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.5000000	0.6000000	0.6666670
α_2	5.00E-01	2.00E-01	8.33E-02
α_3		2.00E-01	1.67E-01
α_4			8.33E-02

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	5.00E-01	6.00E-01	6.67E-01
Beta	5.00E-01	4.00E-01	3.33E-01
Gamma		5.00E-01	7.50E-01
Delta			3.33E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	1.00	1.50	2.00
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

1.1.10.4 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
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 : 2009/12/31

Total Number of Independent Failure Events: 11.10
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8386610	0.9370290	0.9494480	0.9927870	0.9173550	2.1346E+01	1.4345E+00
α_2	7.21E-03	6.30E-02	5.05E-02	1.61E-01	8.26E-02	1.4345E+00	2.1346E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9003620	0.9565080	0.9626720	0.9915560	0.9433430	4.6205E+01	2.1009E+00
α_2	2.70E-03	2.76E-02	2.14E-02	7.38E-02	2.83E-02	1.3337E+00	4.6972E+01
α_3	3.87E-04	1.59E-02	9.87E-03	5.19E-02	2.83E-02	7.6722E-01	4.7539E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9159780	0.9598960	0.9641320	0.9893090	0.9568970	6.8336E+01	2.8551E+00
α_2	2.42E-03	2.08E-02	1.65E-02	5.38E-02	1.08E-02	1.4781E+00	6.9713E+01
α_3	5.07E-04	1.27E-02	8.52E-03	3.92E-02	2.16E-02	9.0431E-01	7.0287E+01
α_4	1.94E-05	6.64E-03	2.89E-03	2.59E-02	1.08E-02	4.7267E-01	7.0718E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9173550	0.9433430	0.9568970
α_2	8.26E-02	2.83E-02	1.08E-02
α_3		2.83E-02	2.16E-02
α_4			1.08E-02

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.17E-01	9.43E-01	9.57E-01
Beta	8.26E-02	5.67E-02	4.31E-02
Gamma		5.00E-01	7.50E-01
Delta			3.33E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	11.10	16.65	22.20
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

1.1.11BWR Standby Liquid Control Pump

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

System : Standby liquid control
Component : Motor Driven Pump
Failure Mode : Fail to run
Fail to Run less than 1 Hour
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 5.20
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8907950	0.9726380	0.9886780	0.9999450	1.0000000	1.5446E+01	4.3452E-01
α_2	5.06E-05	2.74E-02	1.13E-02	1.09E-01	0.00E+00	4.3452E-01	1.5446E+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	5.20
N_1	0.0000
N_2	0.0000

1.1.11.2 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 : 2009/12/31

Total Number of Independent Failure Events: 11.50
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9210710	0.9801290	0.9916810	0.9999550	0.9991450	2.1926E+01	4.4452E-01
α_2	4.16E-05	1.99E-02	8.32E-03	7.89E-02	8.55E-04	4.4452E-01	2.1926E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2
α_1	0.9991450
α_2	8.55E-04

MGL Parameter	CCCG=2
1-Beta	9.99E-01
Beta	8.55E-04

Avg. Impact Vector	CCCG=2
Adj. Ind. Events	11.50
N_1	0.1800
N_2	0.0100

1.1.12Component Cooling Water Pumps

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

System :	Component cooling water
Component :	Motor Driven Pump
Failure Mode :	Fail to run
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 50.00
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9060250	0.9631300	0.9703610	0.9954610	0.9644660	3.9649E+01	1.5178E+00
α_2	4.54E-03	3.69E-02	2.96E-02	9.40E-02	3.55E-02	1.5178E+00	3.9649E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9309240	0.9689720	0.9730090	0.9932100	0.9722900	7.3415E+01	2.3509E+00
α_2	9.01E-04	1.43E-02	1.03E-02	4.14E-02	5.54E-03	1.0837E+00	7.4682E+01
α_3	1.47E-03	1.67E-02	1.27E-02	4.58E-02	2.22E-02	1.2672E+00	7.4499E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3
α_1	0.9644660	0.9722900
α_2	3.55E-02	5.54E-03
α_3		2.22E-02

MGL Parameter	CCCG=2	CCCG=3
1-Beta	9.64E-01	9.72E-01
Beta	3.55E-02	2.77E-02
Gamma		8.00E-01

Avg. Impact Vector	CCCG=2	CCCG=3
Adj. Ind. Events	28.57	42.86
N_1	0.8333	1.0000
N_2	1.0833	0.2500
N_3		1.0000

1.1.12.2 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 :	2009/12/31

Total Number of Independent Failure Events: 75.20
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9796120	0.9949400	0.9979780	0.9999920	1.0000000	8.5446E+01	4.3452E-01
α_2	9.01E-06	5.06E-03	2.03E-03	2.04E-02	0.00E+00	4.3452E-01	8.5446E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9700380	0.9896000	0.9924810	0.9993210	1.0000000	1.0475E+02	1.1009E+00
α_2	2.47E-04	7.88E-03	5.07E-03	2.51E-02	0.00E+00	8.3366E-01	1.0502E+02
α_3	8.78E-08	2.52E-03	5.05E-04	1.20E-02	0.00E+00	2.6722E-01	1.0558E+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	75.20	75.20
N_1	0.0000	0.0000
N_2	0.0000	0.0000
N_3		0.0000

1.1.13RHR Service Water

1.2 Turbine Driven Pumps

1.2.1 Pooled Turbine Driven Pumps

1.2.1.1 TURBINE DRIVEN PUMP FAIL TO RUN >1H SPAR: TDP-FR

Component :	Turbine Driven Pump
Failure Mode :	Fail to run
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 98.20
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9839160	0.9960090	0.9984070	0.9999860	1.0000000	1.0845E+02	4.3452E-01
α_2	7.09E-06	3.99E-03	1.59E-03	1.61E-02	0.00E+00	4.3452E-01	1.0845E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9753630	0.9914560	0.9938270	0.9994420	1.0000000	1.2775E+02	1.1009E+00
α_2	2.03E-04	6.47E-03	4.16E-03	2.06E-02	0.00E+00	8.3366E-01	1.2802E+02
α_3	7.20E-08	2.07E-03	4.15E-04	9.84E-03	0.00E+00	2.6722E-01	1.2858E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9693440	0.9873110	0.9894540	0.9979350	1.0000000	1.4434E+02	1.8551E+00
α_2	6.89E-04	8.40E-03	6.29E-03	2.33E-02	0.00E+00	1.2281E+00	1.4497E+02
α_3	3.09E-06	2.77E-03	1.02E-03	1.14E-02	0.00E+00	4.0431E-01	1.4579E+02
α_4	6.54E-09	1.52E-03	2.07E-04	7.63E-03	0.00E+00	2.2267E-01	1.4597E+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	98.20	98.20	98.20
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

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

Component : Turbine Driven Pump
Failure Mode : Fail to Run less than 1 Hour
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 47.60
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9699900	0.9925440	0.9970090	0.9999850	1.0000000	5.7846E+01	4.3452E-01
α_2	1.33E-05	7.46E-03	2.99E-03	3.00E-02	0.00E+00	4.3452E-01	5.7846E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9595470	0.9859320	0.9898030	0.9990790	1.0000000	7.7155E+01	1.1009E+00
α_2	3.35E-04	1.07E-02	6.87E-03	3.39E-02	0.00E+00	8.3366E-01	7.7422E+01
α_3	1.19E-07	3.41E-03	6.85E-04	1.62E-02	0.00E+00	2.6722E-01	7.7989E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9532610	0.9805940	0.9838380	0.9968340	1.0000000	9.3736E+01	1.8551E+00
α_2	1.06E-03	1.28E-02	9.64E-03	3.56E-02	0.00E+00	1.2281E+00	9.4363E+01
α_3	4.75E-06	4.23E-03	1.56E-03	1.75E-02	0.00E+00	4.0431E-01	9.5187E+01
α_4	1.00E-08	2.33E-03	3.18E-04	1.17E-02	0.00E+00	2.2267E-01	9.5368E+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	47.60	47.60	47.60
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

1.2.1.3 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 : 2009/12/31

Total Number of Independent Failure Events: 159.90
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9897880	0.9974680	0.9989930	0.9999910	1.0000000	1.7115E+02	4.3452E-01
α_2	4.49E-06	2.53E-03	1.01E-03	1.02E-02	0.00E+00	4.3452E-01	1.7115E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9882350	0.9959300	0.9970710	0.9997350	1.0000000	2.6940E+02	1.1009E+00
α_2	9.62E-05	3.08E-03	1.98E-03	9.84E-03	0.00E+00	8.3366E-01	2.6967E+02
α_3	3.42E-08	9.88E-04	1.97E-04	4.69E-03	0.00E+00	2.6722E-01	2.7023E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9877760	0.9949560	0.9958220	0.9991830	1.0000000	3.6594E+02	1.8551E+00
α_2	2.73E-04	3.34E-03	2.49E-03	9.29E-03	0.00E+00	1.2281E+00	3.6657E+02
α_3	1.23E-06	1.10E-03	4.04E-04	4.55E-03	0.00E+00	4.0431E-01	3.6739E+02
α_4	2.59E-09	6.05E-04	8.23E-05	3.03E-03	0.00E+00	2.2267E-01	3.6757E+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	159.90	239.85	319.80
N_1	1.0000	0.0000	0.0000
N_2	0.0000	0.0000	0.0000
N_3		0.0000	0.0000
N_4			0.0000

1.2.2 AFW Turbine-Driven Pumps

1.2.2.1 AFW TURBINE DRIVEN PUMP FAIL TO RUN >1H SPAR

System : Auxiliary feedwater
Component : Turbine Driven Pump
Failure Mode : Fail to run
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 19.60
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9423940	0.9856500	0.9941790	0.9999720	1.0000000	2.9846E+01	4.3452E-01
α_2	2.60E-05	1.43E-02	5.82E-03	5.76E-02	0.00E+00	4.3452E-01	2.9846E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9372610	0.9780950	0.9840520	0.9985620	1.0000000	4.9155E+01	1.1009E+00
α_2	5.25E-04	1.66E-02	1.08E-02	5.26E-02	0.00E+00	8.3366E-01	4.9422E+01
α_3	1.86E-07	5.32E-03	1.07E-03	2.52E-02	0.00E+00	2.6722E-01	4.9989E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9341490	0.9725540	0.9770760	0.9954920	1.0000000	6.5736E+01	1.8551E+00
α_2	1.50E-03	1.82E-02	1.37E-02	5.02E-02	0.00E+00	1.2281E+00	6.6363E+01
α_3	6.73E-06	5.98E-03	2.22E-03	2.47E-02	0.00E+00	4.0431E-01	6.7187E+01
α_4	1.42E-08	3.29E-03	4.51E-04	1.65E-02	0.00E+00	2.2267E-01	6.7368E+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	19.60	19.60	19.60
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

1.2.2.2 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 : 2009/12/31

Total Number of Independent Failure Events: 62.90
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9762110	0.9940950	0.9976370	0.9999880	1.0000000	7.3146E+01	4.3452E-01
α_2	1.05E-05	5.91E-03	2.37E-03	2.38E-02	0.00E+00	4.3452E-01	7.3146E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9661230	0.9882330	0.9914870	0.9992310	1.0000000	9.2455E+01	1.1009E+00
α_2	2.80E-04	8.91E-03	5.74E-03	2.84E-02	0.00E+00	8.3366E-01	9.2722E+01
α_3	9.94E-08	2.86E-03	5.72E-04	1.35E-02	0.00E+00	2.6722E-01	9.3289E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9596620	0.9832720	0.9860820	0.9972760	1.0000000	1.0904E+02	1.8551E+00
α_2	9.10E-04	1.11E-02	8.30E-03	3.07E-02	0.00E+00	1.2281E+00	1.0967E+02
α_3	4.09E-06	3.65E-03	1.35E-03	1.51E-02	0.00E+00	4.0431E-01	1.1049E+02
α_4	8.63E-09	2.01E-03	2.74E-04	1.01E-02	0.00E+00	2.2267E-01	1.1067E+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	62.90	62.90	62.90
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

1.2.2.3 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 : 2009/12/31

Total Number of Independent Failure Events: 33.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9599930	0.9900520	0.9959880	0.9999800	1.0000000	4.3246E+01	4.3452E-01
α_2	1.79E-05	9.95E-03	4.01E-03	4.00E-02	0.00E+00	4.3452E-01	4.3246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9503450	0.9827060	0.9874400	0.9988710	1.0000000	6.2555E+01	1.1009E+00
α_2	4.13E-04	1.31E-02	8.46E-03	4.16E-02	0.00E+00	8.3366E-01	6.2822E+01
α_3	1.47E-07	4.20E-03	8.43E-04	1.99E-02	0.00E+00	2.6722E-01	6.3389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9449240	0.9770950	0.9809010	0.9962540	1.0000000	7.9136E+01	1.8551E+00
α_2	1.25E-03	1.52E-02	1.14E-02	4.20E-02	0.00E+00	1.2281E+00	7.9763E+01
α_3	5.61E-06	4.99E-03	1.85E-03	2.06E-02	0.00E+00	4.0431E-01	8.0587E+01
α_4	1.18E-08	2.75E-03	3.76E-04	1.38E-02	0.00E+00	2.2267E-01	8.0768E+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	33.00	33.00	33.00
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

1.2.2.4 AFW TURBINE DRIVEN PUMP FAIL TO RUN: AFW-TDP-FR

System :	Auxiliary feedwater
Component :	Turbine Driven Pump
Failure Mode :	Fail to run
	Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 52.60
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9723490	0.9931330	0.9972430	0.9999860	1.0000000	6.2846E+01	4.3452E-01
α_2	1.23E-05	6.87E-03	2.76E-03	2.76E-02	0.00E+00	4.3452E-01	6.2846E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9619560	0.9867770	0.9904200	0.9991350	1.0000000	8.2155E+01	1.1009E+00
α_2	3.15E-04	1.00E-02	6.46E-03	3.18E-02	0.00E+00	8.3366E-01	8.2422E+01
α_3	1.12E-07	3.21E-03	6.43E-04	1.52E-02	0.00E+00	2.6722E-01	8.2989E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9555650	0.9815580	0.9846470	0.9969940	1.0000000	9.8736E+01	1.8551E+00
α_2	1.00E-03	1.22E-02	9.16E-03	3.38E-02	0.00E+00	1.2281E+00	9.9363E+01
α_3	4.51E-06	4.02E-03	1.49E-03	1.66E-02	0.00E+00	4.0431E-01	1.0019E+02
α_4	9.52E-09	2.21E-03	3.02E-04	1.11E-02	0.00E+00	2.2267E-01	1.0037E+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	52.60	52.60	52.60
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

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

1.2.3.1 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 :	2009/12/31

Total Number of Independent Failure Events: 84.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9817000	0.9954590	0.9981860	0.9999930	1.0000000	9.5246E+01	4.3452E-01
α_2	8.08E-06	4.54E-03	1.82E-03	1.83E-02	0.00E+00	4.3452E-01	9.5246E+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	84.00
N_1	1.0000
N_2	0.0000

1.2.3.2 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 :	2009/12/31

Total Number of Independent Failure Events: 14.60
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9310850	0.9828120	0.9929990	0.9999660	1.0000000	2.4846E+01	4.3452E-01
α_2	3.12E-05	1.72E-02	7.00E-03	6.89E-02	0.00E+00	4.3452E-01	2.4846E+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	14.60
N_1	0.0000
N_2	0.0000

1.2.3.3 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
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 19.60
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9423940	0.9856500	0.9941790	0.9999720	1.0000000	2.9846E+01	4.3452E-01
α_2	2.60E-05	1.43E-02	5.82E-03	5.76E-02	0.00E+00	4.3452E-01	2.9846E+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	19.60
N_1	0.0000
N_2	0.0000

1.2.3.4 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 Fail to Run less than 1 Hour
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 34.20
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9610590	0.9903180	0.9960960	0.9999810	1.0000000	4.4446E+01	4.3452E-01
α_2	1.74E-05	9.68E-03	3.90E-03	3.89E-02	0.00E+00	4.3452E-01	4.4446E+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	34.20
N_1	0.0000
N_2	0.0000

1.3 Motor Operated Valves

1.3.1 Pooled Motor Operated Valve Distributions

1.3.1.1 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 : 2009/12/31

Total Number of Independent Failure Events: 254.60
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9489980	0.9796210	0.9834370	0.9971960	0.9827170	7.9065E+01	1.6448E+00
α_2	2.81E-03	2.04E-02	1.66E-02	5.10E-02	1.73E-02	1.6448E+00	7.9065E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9578070	0.9804960	0.9828220	0.9952440	0.9853190	1.3231E+02	2.6319E+00
α_2	2.12E-03	1.34E-02	1.11E-02	3.27E-02	9.41E-03	1.8146E+00	1.3313E+02
α_3	1.78E-04	6.06E-03	3.86E-03	1.94E-02	5.28E-03	8.1732E-01	1.3412E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9608680	0.9800630	0.9817530	0.9934760	0.9865520	1.8270E+02	3.7167E+00
α_2	2.23E-03	1.15E-02	9.78E-03	2.65E-02	6.58E-03	2.1395E+00	1.8428E+02
α_3	3.87E-04	5.92E-03	4.28E-03	1.71E-02	5.06E-03	1.1045E+00	1.8531E+02
α_4	7.37E-06	2.54E-03	1.10E-03	9.93E-03	1.81E-03	4.7267E-01	1.8594E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9633870	0.9792780	0.9804390	0.9911920	0.9878130	2.6656E+02	5.6406E+00
α_2	2.72E-03	1.04E-02	9.26E-03	2.22E-02	4.21E-03	2.8410E+00	2.6936E+02
α_3	1.10E-03	6.81E-03	5.64E-03	1.65E-02	5.08E-03	1.8529E+00	2.7035E+02
α_4	6.10E-05	2.75E-03	1.67E-03	9.13E-03	2.17E-03	7.4939E-01	2.7145E+02
α_5	6.10E-10	7.25E-04	7.26E-05	3.75E-03	7.25E-04	1.9728E-01	2.7200E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9663590	0.9803790	0.9813460	0.9910880	0.9895780	3.2136E+02	6.4317E+00
α_2	1.69E-03	7.49E-03	6.51E-03	1.66E-02	1.04E-03	2.4537E+00	3.2534E+02
α_3	1.60E-03	7.30E-03	6.32E-03	1.63E-02	6.06E-03	2.3928E+00	3.2540E+02
α_4	1.39E-04	2.95E-03	2.02E-03	8.93E-03	1.82E-03	9.6722E-01	3.2682E+02
α_5	4.16E-06	1.44E-03	6.23E-04	5.64E-03	1.21E-03	4.7220E-01	3.2732E+02
α_6	2.27E-12	4.45E-04	1.66E-05	2.46E-03	3.03E-04	1.4574E-01	3.2765E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9676980	0.9799190	0.9806540	0.9896210	0.9908050	4.2248E+02	8.6578E+00
α_2	2.31E-03	7.72E-03	6.98E-03	1.57E-02	1.01E-03	3.3297E+00	4.2781E+02
α_3	1.21E-03	5.54E-03	4.80E-03	1.24E-02	3.15E-03	2.3895E+00	4.2875E+02
α_4	5.65E-04	3.95E-03	3.21E-03	9.84E-03	2.96E-03	1.7014E+00	4.2944E+02
α_5	6.04E-05	1.94E-03	1.24E-03	6.18E-03	1.30E-03	8.3427E-01	4.3030E+02
α_6	2.65E-07	7.95E-04	2.37E-04	3.48E-03	6.50E-04	3.4258E-01	4.3080E+02
α_7	3.85E-25	1.40E-04	1.41E-08	7.87E-04	1.30E-04	6.0371E-02	4.3108E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9694380	0.9805480	0.9811820	0.9894910	0.9916920	4.9113E+02	9.7430E+00
α_2	2.33E-03	7.26E-03	6.62E-03	1.44E-02	1.07E-03	3.6388E+00	4.9723E+02
α_3	8.74E-04	4.38E-03	3.74E-03	1.01E-02	1.66E-03	2.1955E+00	4.9868E+02
α_4	6.03E-04	3.72E-03	3.08E-03	9.00E-03	2.60E-03	1.8610E+00	4.9901E+02
α_5	1.77E-04	2.36E-03	1.74E-03	6.66E-03	1.72E-03	1.1808E+00	4.9969E+02
α_6	1.14E-05	1.20E-03	6.34E-04	4.31E-03	8.53E-04	6.0136E-01	5.0027E+02
α_7	1.31E-09	4.33E-04	5.51E-05	2.18E-03	3.41E-04	2.1677E-01	5.0066E+02
α_8	2.32E-30	9.73E-05	7.74E-10	5.13E-04	5.68E-05	4.8724E-02	5.0082E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9827170	0.9853190	0.9865520	0.9878130	0.9895780	0.9908050	0.9916920
α_2	1.73E-02	9.41E-03	6.58E-03	4.21E-03	1.04E-03	1.01E-03	1.07E-03
α_3		5.28E-03	5.06E-03	5.08E-03	6.06E-03	3.15E-03	1.66E-03
α_4			1.81E-03	2.17E-03	1.82E-03	2.96E-03	2.60E-03
α_5				7.25E-04	1.21E-03	1.30E-03	1.72E-03
α_6					3.03E-04	6.50E-04	8.53E-04
α_7						1.30E-04	3.41E-04
α_8							5.68E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.83E-01	9.85E-01	9.87E-01	9.88E-01	9.90E-01	9.91E-01	9.92E-01
Beta	1.73E-02	1.47E-02	1.34E-02	1.22E-02	1.04E-02	9.20E-03	8.31E-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	67.89	101.84	135.79	169.73	203.68	237.63	271.57
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

1.3.1.2 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 : 2009/12/31

Total Number of Independent Failure Events: 20.50
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8790650	0.9670820	0.9833330	0.9997950	0.9814470	1.5912E+01	5.4162E-01
α_2	2.03E-04	3.29E-02	1.67E-02	1.21E-01	1.86E-02	5.4162E-01	1.5912E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9069420	0.9645950	0.9721790	0.9962680	0.9664220	3.7781E+01	1.3867E+00
α_2	1.86E-03	2.81E-02	2.06E-02	8.03E-02	3.15E-02	1.1016E+00	3.8066E+01
α_3	4.90E-07	7.28E-03	1.65E-03	3.38E-02	2.10E-03	2.8512E-01	3.8883E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9117700	0.9601980	0.9652780	0.9912250	0.9552720	5.6815E+01	2.3551E+00
α_2	3.92E-03	2.80E-02	2.29E-02	6.97E-02	3.83E-02	1.6567E+00	5.7513E+01
α_3	2.44E-05	8.04E-03	3.53E-03	3.13E-02	6.39E-03	4.7571E-01	5.8694E+01
α_4	1.63E-08	3.76E-03	5.16E-04	1.89E-02	0.00E+00	2.2267E-01	5.8947E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9294330	0.9625300	0.9652170	0.9864300	0.9482100	1.0924E+02	4.2526E+00
α_2	5.75E-03	2.33E-02	2.06E-02	5.03E-02	3.88E-02	2.6499E+00	1.1084E+02
α_3	7.38E-04	1.02E-02	7.49E-03	2.89E-02	1.29E-02	1.1560E+00	1.1234E+02
α_4	2.17E-06	3.30E-03	1.11E-03	1.40E-02	0.00E+00	3.7439E-01	1.1312E+02
α_5	5.26E-21	6.37E-04	3.60E-07	3.69E-03	0.00E+00	7.2277E-02	1.1342E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9325690	0.9624170	0.9646370	0.9846720	0.9454940	1.3243E+02	5.1715E+00
α_2	5.18E-03	2.02E-02	1.79E-02	4.29E-02	3.27E-02	2.7749E+00	1.3483E+02
α_3	1.29E-03	1.09E-02	8.63E-03	2.82E-02	2.18E-02	1.4989E+00	1.3610E+02
α_4	3.85E-05	4.30E-03	2.25E-03	1.55E-02	0.00E+00	5.9222E-01	1.3701E+02
α_5	6.75E-09	1.61E-03	2.19E-04	8.09E-03	0.00E+00	2.2220E-01	1.3738E+02
α_6	1.02E-18	6.05E-04	1.06E-06	3.53E-03	0.00E+00	8.3237E-02	1.3752E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9814470	0.9664220	0.9552720	0.9482100	0.9454940
α_2	1.86E-02	3.15E-02	3.83E-02	3.88E-02	3.27E-02
α_3		2.10E-03	6.39E-03	1.29E-02	2.18E-02
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	9.81E-01	9.66E-01	9.55E-01	9.48E-01	9.45E-01
Beta	1.86E-02	3.36E-02	4.47E-02	5.18E-02	5.45E-02
Gamma		6.26E-02	1.43E-01	2.50E-01	4.00E-01
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	5.13	7.69	10.25	12.81	15.38
N_1	0.5357	0.5357	0.4286	0.2679	0.1071
N_2	0.1071	0.2679	0.4286	0.5357	0.5357
N_3		0.0179	0.0714	0.1786	0.3571
N_4			0.0000	0.0000	0.0000
N_5				0.0000	0.0000
N_6					0.0000

1.3.1.3 MOV FAIL TO OPERATE ALL SYSTEMS SPAR: MOV-FO

Component : Motor Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to open on demand
Fail to Operate (Open/Close)
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 461.40
Total Number of Common-Cause Failure Events: 8

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9732510	0.9888900	0.9907480	0.9981640	0.9908840	1.6718E+02	1.8782E+00
α_2	1.83E-03	1.11E-02	9.25E-03	2.68E-02	9.12E-03	1.8782E+00	1.6718E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9747020	0.9875260	0.9887180	0.9962600	0.9905640	2.6377E+02	3.3319E+00
α_2	2.18E-03	9.41E-03	8.22E-03	2.07E-02	7.11E-03	2.5146E+00	2.6459E+02
α_3	8.99E-05	3.06E-03	1.94E-03	9.84E-03	2.33E-03	8.1732E-01	2.6628E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9743950	0.9858720	0.9867550	0.9943240	0.9896180	3.5705E+02	5.1167E+00
α_2	3.07E-03	9.77E-03	8.89E-03	1.95E-02	7.36E-03	3.5395E+00	3.5863E+02
α_3	1.99E-04	3.05E-03	2.20E-03	8.81E-03	2.23E-03	1.1045E+00	3.6106E+02
α_4	3.79E-06	1.31E-03	5.65E-04	5.11E-03	7.96E-04	4.7267E-01	3.6169E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9750600	0.9850560	0.9857100	0.9928100	0.9903180	4.8166E+02	7.3073E+00
α_2	3.01E-03	8.54E-03	7.88E-03	1.63E-02	5.29E-03	4.1744E+00	4.8479E+02
α_3	8.87E-04	4.47E-03	3.82E-03	1.03E-02	3.11E-03	2.1862E+00	4.8678E+02
α_4	3.39E-05	1.53E-03	9.29E-04	5.09E-03	9.63E-04	7.4939E-01	4.8822E+02
α_5	3.39E-10	4.03E-04	4.04E-05	2.09E-03	3.21E-04	1.9728E-01	4.8877E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9767560	0.9856490	0.9861940	0.9926740	0.9910940	5.7908E+02	8.4315E+00
α_2	2.23E-03	6.63E-03	6.08E-03	1.29E-02	3.56E-03	3.8981E+00	5.8361E+02
α_3	1.25E-03	4.83E-03	4.28E-03	1.03E-02	3.64E-03	2.8372E+00	5.8467E+02
α_4	1.13E-04	1.84E-03	1.31E-03	5.35E-03	1.04E-03	1.0783E+00	5.8643E+02
α_5	2.32E-06	8.04E-04	3.47E-04	3.15E-03	5.36E-04	4.7220E-01	5.8704E+02
α_6	1.27E-12	2.48E-04	9.25E-06	1.37E-03	1.34E-04	1.4574E-01	5.8737E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9775410	0.9854760	0.9859120	0.9919130	0.9922460	7.2315E+02	1.0658E+01
α_2	2.21E-03	6.03E-03	5.59E-03	1.14E-02	2.46E-03	4.4260E+00	7.2938E+02
α_3	1.14E-03	4.13E-03	3.69E-03	8.64E-03	2.58E-03	3.0339E+00	7.3077E+02
α_4	4.44E-04	2.62E-03	2.19E-03	6.29E-03	1.72E-03	1.9237E+00	7.3188E+02
α_5	4.21E-05	1.19E-03	7.76E-04	3.73E-03	6.43E-04	8.7127E-01	7.3294E+02
α_6	1.56E-07	4.67E-04	1.39E-04	2.04E-03	2.88E-04	3.4258E-01	7.3347E+02
α_7	2.26E-25	8.23E-05	8.29E-09	4.62E-04	5.76E-05	6.0371E-02	7.3375E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9789350	0.9861280	0.9865060	0.9920250	0.9930970	8.3476E+02	1.1743E+01
α_2	1.95E-03	5.29E-03	4.90E-03	9.94E-03	1.82E-03	4.4763E+00	8.4203E+02
α_3	9.14E-04	3.44E-03	3.06E-03	7.27E-03	1.89E-03	2.9106E+00	8.4359E+02
α_4	5.17E-04	2.60E-03	2.22E-03	5.97E-03	1.69E-03	2.1973E+00	8.4431E+02
α_5	1.34E-04	1.51E-03	1.14E-03	4.15E-03	9.21E-04	1.2796E+00	8.4522E+02
α_6	7.52E-06	7.25E-04	3.88E-04	2.59E-03	3.98E-04	6.1366E-01	8.4589E+02
α_7	7.77E-10	2.56E-04	3.26E-05	1.29E-03	1.51E-04	2.1677E-01	8.4629E+02
α_8	1.37E-30	5.76E-05	4.58E-10	3.03E-04	2.51E-05	4.8724E-02	8.4645E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9908840	0.9905640	0.9896180	0.9903180	0.9910940	0.9922460	0.9930970
α_2	9.12E-03	7.11E-03	7.36E-03	5.29E-03	3.56E-03	2.46E-03	1.82E-03
α_3		2.33E-03	2.23E-03	3.11E-03	3.64E-03	2.58E-03	1.89E-03
α_4			7.96E-04	9.63E-04	1.04E-03	1.72E-03	1.69E-03
α_5				3.21E-04	5.36E-04	6.43E-04	9.21E-04
α_6					1.34E-04	2.88E-04	3.98E-04
α_7						5.76E-05	1.51E-04
α_8							2.51E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.91E-01	9.91E-01	9.90E-01	9.90E-01	9.91E-01	9.92E-01	9.93E-01
Beta	9.12E-03	9.44E-03	1.04E-02	9.68E-03	8.91E-03	7.75E-03	6.90E-03
Gamma		2.47E-01	2.91E-01	4.53E-01	6.01E-01	6.82E-01	7.36E-01
Delta			2.63E-01	2.93E-01	3.20E-01	5.12E-01	6.28E-01
Epsilon				2.50E-01	3.91E-01	3.65E-01	4.69E-01
Mu					2.00E-01	3.49E-01	3.84E-01
Upsilon						1.67E-01	3.07E-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	153.80	230.70	307.60	384.50	461.40	538.30	615.20
N_1	3.1293	3.5132	3.3099	1.0032	0.7430	0.7972	0.8319
N_2	1.4437	1.6809	2.3114	2.0602	1.6589	1.3382	1.1316
N_3		0.5501	0.7002	1.2088	1.6954	1.4027	1.1722
N_4			0.2500	0.3750	0.4861	0.9348	1.0508
N_5				0.1250	0.2500	0.3495	0.5713
N_6					0.0625	0.1563	0.2467
N_7						0.0313	0.0938
N_8							0.0156

1.3.1.4 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 : 2009/12/31

Total Number of Independent Failure Events: 184.80
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9758110	0.9929880	0.9960050	0.9998950	0.9972410	9.4576E+01	6.6782E-01
α_2	1.03E-04	7.01E-03	3.99E-03	2.42E-02	2.76E-03	6.6782E-01	9.4576E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9720380	0.9885400	0.9905400	0.9982110	0.9944660	1.5535E+02	1.8009E+00
α_2	1.20E-03	9.76E-03	7.77E-03	2.51E-02	5.53E-03	1.5337E+00	1.5562E+02
α_3	5.90E-08	1.70E-03	3.40E-04	8.07E-03	0.00E+00	2.6722E-01	1.5688E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9693020	0.9849440	0.9864160	0.9955690	0.9916770	2.1294E+02	3.2551E+00
α_2	2.95E-03	1.22E-02	1.07E-02	2.64E-02	8.32E-03	2.6281E+00	2.1357E+02
α_3	2.09E-06	1.87E-03	6.89E-04	7.74E-03	0.00E+00	4.0431E-01	2.1579E+02
α_4	4.41E-09	1.03E-03	1.40E-04	5.16E-03	0.00E+00	2.2267E-01	2.1597E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9694300	0.9830470	0.9840830	0.9931140	0.9919620	3.0182E+02	5.2049E+00
α_2	3.45E-03	1.12E-02	1.02E-02	2.26E-02	6.43E-03	3.4475E+00	3.0358E+02
α_3	3.96E-04	4.27E-03	3.25E-03	1.16E-02	1.61E-03	1.3107E+00	3.0571E+02
α_4	7.99E-07	1.22E-03	4.09E-04	5.18E-03	0.00E+00	3.7439E-01	3.0665E+02
α_5	1.94E-21	2.35E-04	1.33E-07	1.36E-03	0.00E+00	7.2277E-02	3.0695E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9706900	0.9830130	0.9838750	0.9923820	0.9919490	3.6334E+02	6.2786E+00
α_2	3.22E-03	9.97E-03	9.10E-03	1.97E-02	5.81E-03	3.6836E+00	3.6593E+02
α_3	5.52E-04	4.29E-03	3.44E-03	1.10E-02	1.79E-03	1.5862E+00	3.6803E+02
α_4	3.37E-05	1.90E-03	1.11E-03	6.46E-03	4.47E-04	7.0332E-01	3.6892E+02
α_5	2.51E-09	6.01E-04	8.13E-05	3.01E-03	0.00E+00	2.2220E-01	3.6940E+02
α_6	3.81E-19	2.25E-04	3.93E-07	1.31E-03	0.00E+00	8.3237E-02	3.6954E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9715390	0.9824050	0.9830690	0.9910020	0.9930910	4.7152E+02	8.4449E+00
α_2	3.08E-03	8.72E-03	8.04E-03	1.66E-02	3.79E-03	4.1841E+00	4.7578E+02
α_3	9.85E-04	4.74E-03	4.07E-03	1.08E-02	2.23E-03	2.2756E+00	4.7769E+02
α_4	2.00E-04	2.52E-03	1.88E-03	7.06E-03	7.68E-04	1.2111E+00	4.7875E+02
α_5	7.97E-06	1.16E-03	5.82E-04	4.30E-03	1.28E-04	5.5877E-01	4.7941E+02
α_6	1.40E-10	3.88E-04	3.31E-05	2.04E-03	0.00E+00	1.8628E-01	4.7978E+02
α_7	0.00E+00	6.06E-05	5.29E-14	2.28E-04	0.00E+00	2.9071E-02	4.7994E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9731250	0.9830060	0.9835780	0.9909240	0.9939490	5.4726E+02	9.4610E+00
α_2	2.65E-03	7.51E-03	6.93E-03	1.44E-02	2.53E-03	4.1822E+00	5.5254E+02
α_3	9.93E-04	4.41E-03	3.83E-03	9.80E-03	2.16E-03	2.4535E+00	5.5427E+02
α_4	3.07E-04	2.66E-03	2.10E-03	6.96E-03	1.02E-03	1.4828E+00	5.5524E+02
α_5	4.09E-05	1.45E-03	9.14E-04	4.68E-03	2.99E-04	8.0713E-01	5.5591E+02
α_6	4.89E-07	6.81E-04	2.32E-04	2.88E-03	3.72E-05	3.7926E-01	5.5634E+02
α_7	2.92E-14	2.21E-04	3.97E-06	1.26E-03	0.00E+00	1.2297E-01	5.5660E+02
α_8	5.48E-43	5.95E-05	8.47E-13	2.51E-04	0.00E+00	3.3124E-02	5.5669E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9972410	0.9944660	0.9916770	0.9919620	0.9919490	0.9930910	0.9939490
α_2	2.76E-03	5.53E-03	8.32E-03	6.43E-03	5.81E-03	3.79E-03	2.53E-03
α_3		0.00E+00	0.00E+00	1.61E-03	1.79E-03	2.23E-03	2.16E-03
α_4			0.00E+00	0.00E+00	4.47E-04	7.68E-04	1.02E-03
α_5				0.00E+00	0.00E+00	1.28E-04	2.99E-04
α_6					0.00E+00	0.00E+00	3.72E-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	9.97E-01	9.94E-01	9.92E-01	9.92E-01	9.92E-01	9.93E-01	9.94E-01
Beta	2.76E-03	5.53E-03	8.32E-03	8.04E-03	8.05E-03	6.91E-03	6.05E-03
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	82.13	123.20	164.27	205.33	246.40	287.47	328.53
N_1	2.2000	2.6000	2.5333	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

1.3.2 PWR Containment Spray Motor Operated Valves

1.3.2.1 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 : 2009/12/31

Total Number of Independent Failure Events: 13.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9279790	0.9820300	0.9926730	0.9999640	1.0000000	2.3746E+01	4.3452E-01
α_2	3.27E-05	1.80E-02	7.33E-03	7.20E-02	0.00E+00	4.3452E-01	2.3746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9287040	0.9750680	0.9818160	0.9983530	1.0000000	4.3055E+01	1.1009E+00
α_2	5.99E-04	1.89E-02	1.23E-02	5.98E-02	0.00E+00	8.3366E-01	4.3322E+01
α_3	2.12E-07	6.05E-03	1.22E-03	2.87E-02	0.00E+00	2.6722E-01	4.3889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9277020	0.9698320	0.9747770	0.9950350	1.0000000	5.9636E+01	1.8551E+00
α_2	1.65E-03	2.00E-02	1.50E-02	5.51E-02	0.00E+00	1.2281E+00	6.0263E+01
α_3	7.41E-06	6.58E-03	2.44E-03	2.72E-02	0.00E+00	4.0431E-01	6.1087E+01
α_4	1.56E-08	3.62E-03	4.96E-04	1.81E-02	0.00E+00	2.2267E-01	6.1268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9380830	0.9687430	0.9714630	0.9900880	1.0000000	1.0966E+02	3.5382E+00
α_2	3.60E-03	1.87E-02	1.59E-02	4.32E-02	0.00E+00	2.1142E+00	1.1108E+02
α_3	4.22E-04	8.63E-03	5.96E-03	2.60E-02	0.00E+00	9.7738E-01	1.1222E+02
α_4	2.17E-06	3.31E-03	1.11E-03	1.40E-02	0.00E+00	3.7439E-01	1.1282E+02
α_5	5.27E-21	6.38E-04	3.61E-07	3.70E-03	0.00E+00	7.2277E-02	1.1313E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9401620	0.9682400	0.9705290	0.9884810	1.0000000	1.3044E+02	4.2787E+00
α_2	3.42E-03	1.66E-02	1.43E-02	3.78E-02	0.00E+00	2.2392E+00	1.3248E+02
α_3	5.97E-04	8.48E-03	6.20E-03	2.41E-02	0.00E+00	1.1418E+00	1.3358E+02
α_4	3.93E-05	4.40E-03	2.30E-03	1.59E-02	0.00E+00	5.9222E-01	1.3413E+02
α_5	6.89E-09	1.65E-03	2.24E-04	8.26E-03	0.00E+00	2.2220E-01	1.3450E+02
α_6	1.05E-18	6.18E-04	1.08E-06	3.61E-03	0.00E+00	8.3237E-02	1.3464E+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	13.50	13.50	13.50	13.50	13.50
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

1.3.2.2 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 : 2009/12/31

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

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	7.00	7.00	7.00	7.00	7.00
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

1.3.3 BWR Residual Heat Removal Motor-Operated Valves

1.3.3.1 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 :	2009/12/31

Total Number of Independent Failure Events: 70.90
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9544520	0.9826290	0.9863500	0.9980820	0.9860920	8.1146E+01	1.4345E+00
α_2	1.92E-03	1.74E-02	1.37E-02	4.56E-02	1.39E-02	1.4345E+00	8.1146E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9646820	0.9847760	0.9870520	0.9971000	0.9906850	1.3590E+02	2.1009E+00
α_2	9.30E-04	9.66E-03	7.42E-03	2.61E-02	4.66E-03	1.3337E+00	1.3667E+02
α_3	1.34E-04	5.56E-03	3.42E-03	1.83E-02	4.66E-03	7.6722E-01	1.3723E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9683330	0.9850360	0.9866980	0.9960690	0.9929970	1.8794E+02	2.8551E+00
α_2	8.92E-04	7.75E-03	6.11E-03	2.02E-02	1.75E-03	1.4781E+00	1.8932E+02
α_3	1.87E-04	4.74E-03	3.16E-03	1.47E-02	3.50E-03	9.0431E-01	1.8989E+02
α_4	7.20E-06	2.48E-03	1.07E-03	9.70E-03	1.75E-03	4.7267E-01	1.9032E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9695380	0.9836720	0.9848160	0.9938940	0.9943900	2.7341E+02	4.5383E+00
α_2	1.65E-03	8.06E-03	6.91E-03	1.84E-02	7.01E-04	2.2392E+00	2.7571E+02
α_3	4.78E-04	4.87E-03	3.74E-03	1.31E-02	2.10E-03	1.3524E+00	2.7660E+02
α_4	5.98E-05	2.70E-03	1.64E-03	8.94E-03	2.10E-03	7.4939E-01	2.7720E+02
α_5	5.97E-10	7.10E-04	7.11E-05	3.67E-03	7.01E-04	1.9728E-01	2.7775E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9716680	0.9842390	0.9851910	0.9935510	0.9953210	3.2964E+02	5.2787E+00
α_2	1.45E-03	6.87E-03	5.92E-03	1.56E-02	2.92E-04	2.3017E+00	3.3262E+02
α_3	4.30E-04	4.16E-03	3.22E-03	1.11E-02	1.17E-03	1.3918E+00	3.3353E+02
α_4	1.37E-04	2.89E-03	1.98E-03	8.74E-03	1.75E-03	9.6722E-01	3.3395E+02
α_5	4.07E-06	1.41E-03	6.10E-04	5.52E-03	1.17E-03	4.7220E-01	3.3445E+02
α_6	2.22E-12	4.35E-04	1.62E-05	2.41E-03	2.92E-04	1.4574E-01	3.3477E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9718620	0.9830650	0.9837900	0.9917810	0.9959860	4.3220E+02	7.4452E+00
α_2	2.01E-03	7.09E-03	6.36E-03	1.47E-02	1.26E-04	3.1191E+00	4.3653E+02
α_3	6.24E-04	4.07E-03	3.34E-03	9.98E-03	6.27E-04	1.7875E+00	4.3786E+02
α_4	2.71E-04	2.96E-03	2.25E-03	8.08E-03	1.25E-03	1.3014E+00	4.3834E+02
α_5	5.93E-05	1.90E-03	1.22E-03	6.06E-03	1.25E-03	8.3427E-01	4.3881E+02
α_6	2.60E-07	7.79E-04	2.32E-04	3.41E-03	6.27E-04	3.4258E-01	4.3930E+02
α_7	3.78E-25	1.37E-04	1.38E-08	7.71E-04	1.26E-04	6.0371E-02	4.3958E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9732040	0.9834350	0.9840600	0.9915250	0.9964860	5.0233E+02	8.4611E+00
α_2	1.98E-03	6.58E-03	5.95E-03	1.33E-02	5.48E-05	3.3603E+00	5.0743E+02
α_3	5.70E-04	3.59E-03	2.96E-03	8.74E-03	3.30E-04	1.8322E+00	5.0896E+02
α_4	2.76E-04	2.70E-03	2.09E-03	7.23E-03	8.24E-04	1.3809E+00	5.0941E+02
α_5	1.08E-04	2.00E-03	1.40E-03	5.94E-03	1.10E-03	1.0208E+00	5.0977E+02
α_6	1.12E-05	1.18E-03	6.21E-04	4.23E-03	8.24E-04	6.0136E-01	5.1019E+02
α_7	1.29E-09	4.24E-04	5.41E-05	2.14E-03	3.30E-04	2.1677E-01	5.1057E+02
α_8	2.27E-30	9.54E-05	7.59E-10	5.03E-04	5.48E-05	4.8724E-02	5.1074E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9860920	0.9906850	0.9929970	0.9943900	0.9953210	0.9959860	0.9964860
α_2	1.39E-02	4.66E-03	1.75E-03	7.01E-04	2.92E-04	1.26E-04	5.48E-05
α_3		4.66E-03	3.50E-03	2.10E-03	1.17E-03	6.27E-04	3.30E-04
α_4			1.75E-03	2.10E-03	1.75E-03	1.25E-03	8.24E-04
α_5				7.01E-04	1.17E-03	1.25E-03	1.10E-03
α_6					2.92E-04	6.27E-04	8.24E-04
α_7						1.26E-04	3.30E-04
α_8							5.48E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.86E-01	9.91E-01	9.93E-01	9.94E-01	9.95E-01	9.96E-01	9.96E-01
Beta	1.39E-02	9.32E-03	7.00E-03	5.61E-03	4.68E-03	4.01E-03	3.51E-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	70.90	106.35	141.80	177.25	212.70	248.15	283.60
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

1.3.3.2 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 : 2009/12/31

Total Number of Independent Failure Events: 46.30
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9491540	0.9873430	0.9948750	0.9999750	1.0000000	3.3896E+01	4.3452E-01
α_2	2.28E-05	1.27E-02	5.12E-03	5.08E-02	0.00E+00	4.3452E-01	3.3896E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9521840	0.9833520	0.9879130	0.9989090	1.0000000	6.5025E+01	1.1009E+00
α_2	3.97E-04	1.26E-02	8.15E-03	4.00E-02	0.00E+00	8.3366E-01	6.5292E+01
α_3	1.41E-07	4.04E-03	8.12E-04	1.92E-02	0.00E+00	2.6722E-01	6.5859E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9531150	0.9805320	0.9837870	0.9968240	1.0000000	9.3436E+01	1.8551E+00
α_2	1.06E-03	1.29E-02	9.67E-03	3.57E-02	0.00E+00	1.2281E+00	9.4063E+01
α_3	4.76E-06	4.24E-03	1.57E-03	1.75E-02	0.00E+00	4.0431E-01	9.4887E+01
α_4	1.01E-08	2.34E-03	3.19E-04	1.17E-02	0.00E+00	2.2267E-01	9.5068E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9553810	0.9775460	0.9795350	0.9929140	1.0000000	1.5404E+02	3.5382E+00
α_2	2.57E-03	1.34E-02	1.14E-02	3.11E-02	0.00E+00	2.1142E+00	1.5546E+02
α_3	3.02E-04	6.20E-03	4.28E-03	1.87E-02	0.00E+00	9.7738E-01	1.5660E+02
α_4	1.56E-06	2.38E-03	7.99E-04	1.01E-02	0.00E+00	3.7439E-01	1.5720E+02
α_5	3.78E-21	4.59E-04	2.59E-07	2.65E-03	0.00E+00	7.2277E-02	1.5751E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9575880	0.9775600	0.9792080	0.9918990	1.0000000	1.8639E+02	4.2787E+00
α_2	2.41E-03	1.17E-02	1.01E-02	2.68E-02	0.00E+00	2.2392E+00	1.8843E+02
α_3	4.21E-04	5.99E-03	4.37E-03	1.71E-02	0.00E+00	1.1418E+00	1.8953E+02
α_4	2.77E-05	3.11E-03	1.62E-03	1.12E-02	0.00E+00	5.9222E-01	1.9008E+02
α_5	4.87E-09	1.17E-03	1.58E-04	5.84E-03	0.00E+00	2.2220E-01	1.9045E+02
α_6	7.39E-19	4.37E-04	7.63E-07	2.55E-03	0.00E+00	8.3237E-02	1.9059E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9593660	0.9762640	0.9774270	0.9891940	1.0000000	2.6508E+02	6.4450E+00
α_2	3.20E-03	1.14E-02	1.02E-02	2.36E-02	0.00E+00	3.0878E+00	2.6844E+02
α_3	8.08E-04	6.01E-03	4.85E-03	1.52E-02	0.00E+00	1.6312E+00	2.6989E+02
α_4	1.82E-04	3.64E-03	2.52E-03	1.09E-02	0.00E+00	9.8887E-01	2.7054E+02
α_5	9.44E-06	1.92E-03	9.09E-04	7.26E-03	0.00E+00	5.2177E-01	2.7100E+02
α_6	2.47E-10	6.86E-04	5.85E-05	3.60E-03	0.00E+00	1.8628E-01	2.7134E+02
α_7	0.00E+00	1.07E-04	9.37E-14	4.03E-04	0.00E+00	2.9071E-02	2.7150E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9612040	0.9765960	0.9775890	0.9886120	1.0000000	3.1133E+02	7.4610E+00
α_2	3.15E-03	1.05E-02	9.49E-03	2.13E-02	0.00E+00	3.3447E+00	3.1545E+02
α_3	8.06E-04	5.45E-03	4.46E-03	1.35E-02	0.00E+00	1.7384E+00	3.1705E+02
α_4	2.54E-04	3.60E-03	2.63E-03	1.03E-02	0.00E+00	1.1465E+00	3.1764E+02
α_5	4.04E-05	2.22E-03	1.30E-03	7.52E-03	0.00E+00	7.0833E-01	3.1808E+02
α_6	6.51E-07	1.15E-03	3.77E-04	4.92E-03	0.00E+00	3.6696E-01	3.1842E+02
α_7	5.11E-14	3.86E-04	6.93E-06	2.20E-03	0.00E+00	1.2297E-01	3.1867E+02
α_8	9.56E-43	1.04E-04	1.48E-12	4.39E-04	0.00E+00	3.3124E-02	3.1876E+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	23.15	34.72	46.30	57.88	69.45	81.03	92.60
N_1	0.5000	0.7500	1.0000	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

1.3.4 BWR Isolation Condenser Motor-Operated Valves

1.3.4.1 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 : 2009/12/31

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

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	6.00	6.00	6.00	6.00	6.00
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

1.3.4.2 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 : 2009/12/31

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

1.3.5 PWR Auxiliary Feedwater Motor-Operated Valves

1.3.5.1 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 :	2009/12/31

Total Number of Independent Failure Events: 23.20
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8854700	0.9669700	0.9813120	0.9995880	0.9765530	1.8576E+01	6.3452E-01
α_2	4.10E-04	3.30E-02	1.87E-02	1.15E-01	2.34E-02	6.3452E-01	1.8576E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9071980	0.9629470	0.9698510	0.9950370	0.9601590	4.1605E+01	1.6009E+00
α_2	2.71E-03	2.97E-02	2.28E-02	8.04E-02	3.59E-02	1.2837E+00	4.1922E+01
α_3	1.31E-06	7.34E-03	1.98E-03	3.29E-02	3.98E-03	3.1722E-01	4.2889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9119230	0.9588110	0.9634770	0.9897350	0.9514270	6.1806E+01	2.6551E+00
α_2	4.57E-03	2.84E-02	2.36E-02	6.83E-02	3.64E-02	1.8281E+00	6.2633E+01
α_3	9.21E-05	9.37E-03	5.01E-03	3.35E-02	1.21E-02	6.0431E-01	6.3857E+01
α_4	1.49E-08	3.45E-03	4.73E-04	1.73E-02	0.00E+00	2.2267E-01	6.4238E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9299610	0.9621900	0.9647310	0.9857230	0.9508120	1.1549E+02	4.5383E+00
α_2	5.29E-03	2.18E-02	1.92E-02	4.72E-02	2.46E-02	2.6142E+00	1.1741E+02
α_3	1.42E-03	1.23E-02	9.72E-03	3.20E-02	2.46E-02	1.4774E+00	1.1855E+02
α_4	2.05E-06	3.12E-03	1.05E-03	1.32E-02	0.00E+00	3.7439E-01	1.1965E+02
α_5	4.97E-21	6.02E-04	3.40E-07	3.49E-03	0.00E+00	7.2277E-02	1.1996E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9351640	0.9637000	0.9658110	0.9850320	0.9586780	1.4014E+02	5.2787E+00
α_2	3.16E-03	1.54E-02	1.32E-02	3.50E-02	0.00E+00	2.2392E+00	1.4318E+02
α_3	2.87E-03	1.47E-02	1.26E-02	3.40E-02	4.13E-02	2.1418E+00	1.4328E+02
α_4	3.64E-05	4.07E-03	2.13E-03	1.47E-02	0.00E+00	5.9222E-01	1.4483E+02
α_5	6.39E-09	1.53E-03	2.07E-04	7.66E-03	0.00E+00	2.2220E-01	1.4520E+02
α_6	9.69E-19	5.72E-04	1.00E-06	3.34E-03	0.00E+00	8.3237E-02	1.4534E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9436710	0.9659370	0.9673480	0.9833820	0.9643750	2.1112E+02	7.4450E+00
α_2	3.98E-03	1.41E-02	1.27E-02	2.92E-02	0.00E+00	3.0878E+00	2.1548E+02
α_3	2.08E-03	1.02E-02	8.76E-03	2.33E-02	2.14E-02	2.2312E+00	2.1633E+02
α_4	6.56E-04	6.35E-03	4.93E-03	1.69E-02	1.43E-02	1.3889E+00	2.1718E+02
α_5	1.17E-05	2.39E-03	1.13E-03	9.02E-03	0.00E+00	5.2177E-01	2.1804E+02
α_6	3.07E-10	8.52E-04	7.28E-05	4.47E-03	0.00E+00	1.8628E-01	2.1838E+02
α_7	0.00E+00	1.33E-04	1.16E-13	5.01E-04	0.00E+00	2.9071E-02	2.1854E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9471990	0.9672210	0.9684240	0.9831430	0.9686810	2.4966E+02	8.4610E+00
α_2	3.90E-03	1.30E-02	1.17E-02	2.62E-02	0.00E+00	3.3447E+00	2.5478E+02
α_3	1.54E-03	8.13E-03	6.90E-03	1.89E-02	1.13E-02	2.0984E+00	2.5602E+02
α_4	8.44E-04	6.30E-03	5.08E-03	1.59E-02	1.50E-02	1.6265E+00	2.5649E+02
α_5	1.18E-04	3.36E-03	2.20E-03	1.06E-02	5.01E-03	8.6833E-01	2.5725E+02
α_6	8.04E-07	1.42E-03	4.65E-04	6.08E-03	0.00E+00	3.6696E-01	2.5775E+02
α_7	6.31E-14	4.76E-04	8.57E-06	2.71E-03	0.00E+00	1.2297E-01	2.5800E+02
α_8	1.18E-42	1.28E-04	1.83E-12	5.42E-04	0.00E+00	3.3124E-02	2.5809E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9765530	0.9601590	0.9514270	0.9508120	0.9586780	0.9643750	0.9686810
α_2	2.34E-02	3.59E-02	3.64E-02	2.46E-02	0.00E+00	0.00E+00	0.00E+00
α_3		3.98E-03	1.21E-02	2.46E-02	4.13E-02	2.14E-02	1.13E-02
α_4			0.00E+00	0.00E+00	0.00E+00	1.43E-02	1.50E-02
α_5				0.00E+00	0.00E+00	0.00E+00	5.01E-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	9.77E-01	9.60E-01	9.51E-01	9.51E-01	9.59E-01	9.64E-01	9.69E-01
Beta	2.34E-02	3.98E-02	4.86E-02	4.92E-02	4.13E-02	3.56E-02	3.13E-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	7.73	11.60	15.47	19.33	23.20	27.07	30.93
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

1.3.5.2 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 : 2009/12/31

Total Number of Independent Failure Events: 24.60
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8963180	0.9695810	0.9822820	0.9995370	0.9793050	2.1286E+01	6.6782E-01
α_2	4.60E-04	3.04E-02	1.77E-02	1.04E-01	2.07E-02	6.6782E-01	2.1286E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9080740	0.9618580	0.9681960	0.9939400	0.9577290	4.5415E+01	1.8009E+00
α_2	4.05E-03	3.25E-02	2.61E-02	8.27E-02	4.23E-02	1.5337E+00	4.5682E+01
α_3	1.98E-07	5.66E-03	1.14E-03	2.68E-02	0.00E+00	2.6722E-01	4.6949E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9058000	0.9532340	0.9575240	0.9860000	0.9352250	6.6349E+01	3.2551E+00
α_2	9.30E-03	3.78E-02	3.34E-02	8.11E-02	6.48E-02	2.6281E+00	6.6976E+01
α_3	6.53E-06	5.81E-03	2.15E-03	2.40E-02	0.00E+00	4.0431E-01	6.9200E+01
α_4	1.38E-08	3.20E-03	4.38E-04	1.60E-02	0.00E+00	2.2267E-01	6.9381E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9262580	0.9587880	0.9611940	0.9831010	0.9373460	1.2109E+02	5.2049E+00
α_2	8.47E-03	2.73E-02	2.48E-02	5.45E-02	5.01E-02	3.4475E+00	1.2285E+02
α_3	9.67E-04	1.04E-02	7.93E-03	2.82E-02	1.25E-02	1.3107E+00	1.2498E+02
α_4	1.95E-06	2.96E-03	9.98E-04	1.26E-02	0.00E+00	3.7439E-01	1.2592E+02
α_5	4.72E-21	5.72E-04	3.23E-07	3.31E-03	0.00E+00	7.2277E-02	1.2622E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9295760	0.9588930	0.9608820	0.9814120	0.9365510	1.4646E+02	6.2786E+00
α_2	7.85E-03	2.41E-02	2.21E-02	4.74E-02	4.58E-02	3.6836E+00	1.4905E+02
α_3	1.34E-03	1.04E-02	8.34E-03	2.64E-02	1.41E-02	1.5862E+00	1.5115E+02
α_4	8.19E-05	4.60E-03	2.70E-03	1.56E-02	3.52E-03	7.0332E-01	1.5204E+02
α_5	6.08E-09	1.45E-03	1.97E-04	7.29E-03	0.00E+00	2.2220E-01	1.5252E+02
α_6	9.23E-19	5.45E-04	9.53E-07	3.18E-03	0.00E+00	8.3237E-02	1.5266E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9401030	0.9627870	0.9641420	0.9808520	0.9451180	2.1849E+02	8.4449E+00
α_2	6.55E-03	1.84E-02	1.70E-02	3.51E-02	3.01E-02	4.1841E+00	2.2275E+02
α_3	2.09E-03	1.00E-02	8.63E-03	2.27E-02	1.77E-02	2.2756E+00	2.2466E+02
α_4	4.24E-04	5.34E-03	3.97E-03	1.49E-02	6.10E-03	1.2111E+00	2.2572E+02
α_5	1.69E-05	2.46E-03	1.23E-03	9.08E-03	1.02E-03	5.5877E-01	2.2638E+02
α_6	2.96E-10	8.21E-04	7.01E-05	4.31E-03	0.00E+00	1.8628E-01	2.2675E+02
α_7	0.00E+00	1.28E-04	1.12E-13	4.82E-04	0.00E+00	2.9071E-02	2.2691E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9443330	0.9646390	0.9657930	0.9810040	0.9516440	2.5809E+02	9.4610E+00
α_2	5.54E-03	1.56E-02	1.44E-02	2.98E-02	2.02E-02	4.1822E+00	2.6337E+02
α_3	2.07E-03	9.17E-03	7.98E-03	2.03E-02	1.73E-02	2.4535E+00	2.6510E+02
α_4	6.40E-04	5.54E-03	4.37E-03	1.45E-02	8.13E-03	1.4828E+00	2.6607E+02
α_5	8.52E-05	3.02E-03	1.90E-03	9.74E-03	2.39E-03	8.0713E-01	2.6674E+02
α_6	1.02E-06	1.42E-03	4.84E-04	6.00E-03	2.97E-04	3.7926E-01	2.6717E+02
α_7	6.08E-14	4.60E-04	8.26E-06	2.62E-03	0.00E+00	1.2297E-01	2.6743E+02
α_8	1.14E-42	1.24E-04	1.76E-12	5.23E-04	0.00E+00	3.3124E-02	2.6752E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9793050	0.9577290	0.9352250	0.9373460	0.9365510	0.9451180	0.9516440
α_2	2.07E-02	4.23E-02	6.48E-02	5.01E-02	4.58E-02	3.01E-02	2.02E-02
α_3		0.00E+00	0.00E+00	1.25E-02	1.41E-02	1.77E-02	1.73E-02
α_4			0.00E+00	0.00E+00	3.52E-03	6.10E-03	8.13E-03
α_5				0.00E+00	0.00E+00	1.02E-03	2.39E-03
α_6					0.00E+00	0.00E+00	2.97E-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	9.79E-01	9.58E-01	9.35E-01	9.37E-01	9.37E-01	9.45E-01	9.52E-01
Beta	2.07E-02	4.23E-02	6.48E-02	6.27E-02	6.34E-02	5.49E-02	4.84E-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	9.84	14.76	19.68	24.60	29.52	34.44	39.36
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

1.3.5.3 AFW MOV FAIL TO OPERATE ALL SYSTEMS SPAR: AFW-MOV-FO

System :	Auxiliary feedwater
Component :	Motor Operated Valve
Failure Mode :	Fail to close (reseat) on demand Fail to open on demand Fail to Operate (Open/Close)
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 50.80
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9156850	0.9728580	0.9819360	0.9990180	0.9796510	3.1106E+01	8.6782E-01
α_2	9.79E-04	2.71E-02	1.81E-02	8.43E-02	2.03E-02	8.6782E-01	3.1106E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9170590	0.9628860	0.9677550	0.9920360	0.9617100	5.9695E+01	2.3009E+00
α_2	5.75E-03	3.20E-02	2.71E-02	7.50E-02	3.67E-02	1.9837E+00	6.0012E+01
α_3	9.10E-07	5.12E-03	1.38E-03	2.30E-02	1.60E-03	3.1722E-01	6.1679E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9134340	0.9544600	0.9578280	0.9839630	0.9464110	8.4989E+01	4.0551E+00
α_2	1.07E-02	3.63E-02	3.28E-02	7.35E-02	4.87E-02	3.2281E+00	8.5816E+01
α_3	6.64E-05	6.79E-03	3.62E-03	2.43E-02	4.87E-03	6.0431E-01	8.8440E+01
α_4	1.08E-08	2.50E-03	3.42E-04	1.25E-02	0.00E+00	2.2267E-01	8.8821E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9291090	0.9587290	0.9607480	0.9814440	0.9473520	1.4414E+02	6.2049E+00
α_2	8.99E-03	2.63E-02	2.42E-02	5.06E-02	3.62E-02	3.9475E+00	1.4640E+02
α_3	1.89E-03	1.20E-02	9.96E-03	2.93E-02	1.65E-02	1.8107E+00	1.4853E+02
α_4	1.63E-06	2.49E-03	8.38E-04	1.06E-02	0.00E+00	3.7439E-01	1.4997E+02
α_5	3.96E-21	4.81E-04	2.72E-07	2.78E-03	0.00E+00	7.2277E-02	1.5027E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9334370	0.9598780	0.9615560	0.9805730	0.9501590	1.7413E+02	7.2786E+00
α_2	6.60E-03	2.03E-02	1.86E-02	3.99E-02	2.40E-02	3.6836E+00	1.7772E+02
α_3	3.41E-03	1.43E-02	1.25E-02	3.11E-02	2.40E-02	2.5862E+00	1.7882E+02
α_4	6.89E-05	3.88E-03	2.27E-03	1.31E-02	1.85E-03	7.0332E-01	1.8071E+02
α_5	5.11E-09	1.22E-03	1.66E-04	6.14E-03	0.00E+00	2.2220E-01	1.8119E+02
α_6	7.76E-19	4.59E-04	8.02E-07	2.68E-03	0.00E+00	8.3237E-02	1.8133E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9428590	0.9637030	0.9648890	0.9805090	0.9569720	2.5077E+02	9.4449E+00
α_2	5.71E-03	1.61E-02	1.49E-02	3.06E-02	1.57E-02	4.1841E+00	2.5603E+02
α_3	2.92E-03	1.11E-02	9.82E-03	2.34E-02	1.78E-02	2.8756E+00	2.5734E+02
α_4	8.18E-04	6.19E-03	4.98E-03	1.57E-02	8.92E-03	1.6111E+00	2.5860E+02
α_5	1.47E-05	2.15E-03	1.07E-03	7.92E-03	5.31E-04	5.5877E-01	2.5966E+02
α_6	2.58E-10	7.16E-04	6.11E-05	3.76E-03	0.00E+00	1.8628E-01	2.6003E+02
α_7	0.00E+00	1.12E-04	9.77E-14	4.20E-04	0.00E+00	2.9071E-02	2.6019E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9471020	0.9657510	0.9667660	0.9809450	0.9621450	2.9498E+02	1.0461E+01
α_2	4.85E-03	1.37E-02	1.26E-02	2.61E-02	1.06E-02	4.1822E+00	3.0126E+02
α_3	2.38E-03	9.21E-03	8.16E-03	1.96E-02	1.36E-02	2.8135E+00	3.0263E+02
α_4	1.12E-03	6.43E-03	5.39E-03	1.53E-02	1.03E-02	1.9628E+00	3.0348E+02
α_5	1.50E-04	3.17E-03	2.17E-03	9.58E-03	3.27E-03	9.6713E-01	3.0447E+02
α_6	8.92E-07	1.24E-03	4.23E-04	5.25E-03	1.55E-04	3.7926E-01	3.0506E+02
α_7	5.33E-14	4.03E-04	7.24E-06	2.29E-03	0.00E+00	1.2297E-01	3.0532E+02
α_8	9.98E-43	1.08E-04	1.54E-12	4.58E-04	0.00E+00	3.3124E-02	3.0541E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9796510	0.9617100	0.9464110	0.9473520	0.9501590	0.9569720	0.9621450
α_2	2.03E-02	3.67E-02	4.87E-02	3.62E-02	2.40E-02	1.57E-02	1.06E-02
α_3		1.60E-03	4.87E-03	1.65E-02	2.40E-02	1.78E-02	1.36E-02
α_4			0.00E+00	0.00E+00	1.85E-03	8.92E-03	1.03E-02
α_5				0.00E+00	0.00E+00	5.31E-04	3.27E-03
α_6					0.00E+00	0.00E+00	1.55E-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	9.80E-01	9.62E-01	9.46E-01	9.47E-01	9.50E-01	9.57E-01	9.62E-01
Beta	2.03E-02	3.83E-02	5.36E-02	5.26E-02	4.98E-02	4.30E-02	3.79E-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	19.06	28.59	38.12	47.65	57.19	66.72	76.25
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

1.3.6 PWR High Pressure Safety Injection Motor-Operated Valves

1.3.6.1 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 :	2009/12/31

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

1.3.6.2 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 open on demand
Start Date : 1997/01/01
Data Version : 2009/12/31

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

1.3.7 PWR Residual Heat Removal Motor-Operated Valves

1.3.7.1 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 :	2009/12/31

Total Number of Independent Failure Events: 50.70
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8982310	0.9743470	0.9892100	0.9999430	0.9987390	1.6819E+01	4.4282E-01
α_2	5.30E-05	2.57E-02	1.08E-02	1.02E-01	1.26E-03	4.4282E-01	1.6819E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9212700	0.9722110	0.9795440	0.9980720	0.9974650	3.9390E+01	1.1259E+00
α_2	7.36E-04	2.12E-02	1.40E-02	6.63E-02	2.54E-03	8.5866E-01	3.9657E+01
α_3	2.32E-07	6.60E-03	1.33E-03	3.13E-02	0.00E+00	2.6722E-01	4.0249E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9259650	0.9688310	0.9738020	0.9946880	0.9961920	5.9216E+01	1.9051E+00
α_2	1.87E-03	2.09E-02	1.60E-02	5.69E-02	3.81E-03	1.2781E+00	5.9843E+01
α_3	7.45E-06	6.61E-03	2.45E-03	2.73E-02	0.00E+00	4.0431E-01	6.0717E+01
α_4	1.57E-08	3.64E-03	4.99E-04	1.82E-02	0.00E+00	2.2267E-01	6.0898E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9385850	0.9688020	0.9714550	0.9899320	0.9949150	1.1246E+02	3.6215E+00
α_2	3.81E-03	1.89E-02	1.62E-02	4.32E-02	5.08E-03	2.1975E+00	1.1388E+02
α_3	4.11E-04	8.42E-03	5.82E-03	2.53E-02	0.00E+00	9.7738E-01	1.1510E+02
α_4	2.12E-06	3.23E-03	1.09E-03	1.37E-02	0.00E+00	3.7439E-01	1.1571E+02
α_5	5.14E-21	6.23E-04	3.52E-07	3.60E-03	0.00E+00	7.2277E-02	1.1601E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9415160	0.9687360	0.9709280	0.9884500	0.9936340	1.3645E+02	4.4037E+00
α_2	3.66E-03	1.68E-02	1.46E-02	3.75E-02	6.37E-03	2.3642E+00	1.3849E+02
α_3	5.70E-04	8.11E-03	5.93E-03	2.31E-02	0.00E+00	1.1418E+00	1.3971E+02
α_4	3.76E-05	4.20E-03	2.20E-03	1.52E-02	0.00E+00	5.9222E-01	1.4026E+02
α_5	6.59E-09	1.58E-03	2.14E-04	7.90E-03	0.00E+00	2.2220E-01	1.4063E+02
α_6	1.00E-18	5.91E-04	1.03E-06	3.45E-03	0.00E+00	8.3237E-02	1.4077E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9473230	0.9689760	0.9704290	0.9856570	0.9923510	2.0676E+02	6.6200E+00
α_2	4.51E-03	1.53E-02	1.38E-02	3.12E-02	7.65E-03	3.2628E+00	2.1012E+02
α_3	1.03E-03	7.64E-03	6.17E-03	1.93E-02	0.00E+00	1.6312E+00	2.1175E+02
α_4	2.32E-04	4.63E-03	3.21E-03	1.39E-02	0.00E+00	9.8887E-01	2.1239E+02
α_5	1.20E-05	2.45E-03	1.16E-03	9.24E-03	0.00E+00	5.2177E-01	2.1286E+02
α_6	3.15E-10	8.73E-04	7.45E-05	4.58E-03	0.00E+00	1.8628E-01	2.1319E+02
α_7	0.00E+00	1.36E-04	1.19E-13	5.13E-04	0.00E+00	2.9071E-02	2.1335E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9498730	0.9695040	0.9707350	0.9849280	0.9910670	2.4461E+02	7.6943E+00
α_2	4.50E-03	1.42E-02	1.29E-02	2.82E-02	8.93E-03	3.5780E+00	2.4873E+02
α_3	1.02E-03	6.89E-03	5.64E-03	1.70E-02	0.00E+00	1.7384E+00	2.5057E+02
α_4	3.22E-04	4.54E-03	3.32E-03	1.29E-02	0.00E+00	1.1465E+00	2.5116E+02
α_5	5.11E-05	2.81E-03	1.65E-03	9.50E-03	0.00E+00	7.0833E-01	2.5160E+02
α_6	8.23E-07	1.45E-03	4.76E-04	6.22E-03	0.00E+00	3.6696E-01	2.5194E+02
α_7	6.45E-14	4.87E-04	8.76E-06	2.77E-03	0.00E+00	1.2297E-01	2.5218E+02
α_8	1.21E-42	1.31E-04	1.87E-12	5.55E-04	0.00E+00	3.3124E-02	2.5227E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9987390	0.9974650	0.9961920	0.9949150	0.9936340	0.9923510	0.9910670
α_2	1.26E-03	2.54E-03	3.81E-03	5.08E-03	6.37E-03	7.65E-03	8.93E-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	9.97E-01	9.96E-01	9.95E-01	9.94E-01	9.92E-01	9.91E-01
Beta	1.26E-03	2.54E-03	3.81E-03	5.08E-03	6.37E-03	7.65E-03	8.93E-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	6.34	9.51	12.68	15.84	19.01	22.18	25.35
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

1.3.7.2 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 :	2009/12/31

Total Number of Independent Failure Events: 23.10
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9483310	0.9871370	0.9947900	0.9999740	1.0000000	3.3346E+01	4.3452E-01
α_2	2.32E-05	1.29E-02	5.21E-03	5.17E-02	0.00E+00	4.3452E-01	3.3346E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9413020	0.9795210	0.9851030	0.9986530	1.0000000	5.2655E+01	1.1009E+00
α_2	4.90E-04	1.55E-02	1.00E-02	4.92E-02	0.00E+00	8.3366E-01	5.2922E+01
α_3	1.74E-07	4.97E-03	1.00E-03	2.36E-02	0.00E+00	2.6722E-01	5.3489E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9373480	0.9739060	0.9782160	0.9957170	1.0000000	6.9236E+01	1.8551E+00
α_2	1.43E-03	1.73E-02	1.30E-02	4.78E-02	0.00E+00	1.2281E+00	6.9863E+01
α_3	6.40E-06	5.69E-03	2.11E-03	2.35E-02	0.00E+00	4.0431E-01	7.0687E+01
α_4	1.35E-08	3.13E-03	4.28E-04	1.57E-02	0.00E+00	2.2267E-01	7.0868E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9428720	0.9711870	0.9737110	0.9908740	1.0000000	1.1926E+02	3.5382E+00
α_2	3.31E-03	1.72E-02	1.47E-02	3.98E-02	0.00E+00	2.1142E+00	1.2068E+02
α_3	3.88E-04	7.96E-03	5.50E-03	2.39E-02	0.00E+00	9.7738E-01	1.2182E+02
α_4	2.00E-06	3.05E-03	1.03E-03	1.29E-02	0.00E+00	3.7439E-01	1.2242E+02
α_5	4.86E-21	5.89E-04	3.33E-07	3.41E-03	0.00E+00	7.2277E-02	1.2273E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9441060	0.9703530	0.9725030	0.9892570	1.0000000	1.4004E+02	4.2787E+00
α_2	3.19E-03	1.55E-02	1.33E-02	3.53E-02	0.00E+00	2.2392E+00	1.4208E+02
α_3	5.57E-04	7.91E-03	5.78E-03	2.25E-02	0.00E+00	1.1418E+00	1.4318E+02
α_4	3.67E-05	4.10E-03	2.15E-03	1.48E-02	0.00E+00	5.9222E-01	1.4373E+02
α_5	6.43E-09	1.54E-03	2.09E-04	7.71E-03	0.00E+00	2.2220E-01	1.4410E+02
α_6	9.77E-19	5.77E-04	1.01E-06	3.37E-03	0.00E+00	8.3237E-02	1.4424E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9484470	0.9698260	0.9712800	0.9862310	1.0000000	2.0715E+02	6.4450E+00
α_2	4.07E-03	1.45E-02	1.30E-02	2.99E-02	0.00E+00	3.0878E+00	2.1051E+02
α_3	1.03E-03	7.64E-03	6.16E-03	1.93E-02	0.00E+00	1.6312E+00	2.1196E+02
α_4	2.32E-04	4.63E-03	3.20E-03	1.39E-02	0.00E+00	9.8887E-01	2.1261E+02
α_5	1.20E-05	2.44E-03	1.16E-03	9.23E-03	0.00E+00	5.2177E-01	2.1307E+02
α_6	3.15E-10	8.72E-04	7.44E-05	4.58E-03	0.00E+00	1.8628E-01	2.1341E+02
α_7	0.00E+00	1.36E-04	1.19E-13	5.12E-04	0.00E+00	2.9071E-02	2.1357E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9504710	0.9700710	0.9713180	0.9854010	1.0000000	2.4183E+02	7.4610E+00
α_2	4.03E-03	1.34E-02	1.21E-02	2.72E-02	0.00E+00	3.3447E+00	2.4595E+02
α_3	1.03E-03	6.97E-03	5.71E-03	1.72E-02	0.00E+00	1.7384E+00	2.4755E+02
α_4	3.26E-04	4.60E-03	3.36E-03	1.31E-02	0.00E+00	1.1465E+00	2.4814E+02
α_5	5.17E-05	2.84E-03	1.67E-03	9.62E-03	0.00E+00	7.0833E-01	2.4858E+02
α_6	8.33E-07	1.47E-03	4.82E-04	6.30E-03	0.00E+00	3.6696E-01	2.4892E+02
α_7	6.53E-14	4.93E-04	8.87E-06	2.81E-03	0.00E+00	1.2297E-01	2.4917E+02
α_8	1.22E-42	1.33E-04	1.89E-12	5.62E-04	0.00E+00	3.3124E-02	2.4926E+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	23.10	23.10	23.10	23.10	23.10	23.10	23.10
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

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

1.3.8.1 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 : 2009/12/31

Total Number of Independent Failure Events: 32.10
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9187570	0.9796760	0.9916400	0.9999590	0.9998150	2.1042E+01	4.3652E-01
α_2	3.82E-05	2.03E-02	8.36E-03	8.12E-02	1.85E-04	4.3652E-01	2.1042E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9325210	0.9763740	0.9827500	0.9984230	0.9996290	4.5743E+01	1.1069E+00
α_2	5.80E-04	1.79E-02	1.17E-02	5.66E-02	3.64E-04	8.3956E-01	4.6010E+01
α_3	2.01E-07	5.71E-03	1.15E-03	2.71E-02	6.18E-06	2.6732E-01	4.6583E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9357400	0.9731720	0.9775710	0.9955580	0.9994630	6.7713E+01	1.8667E+00
α_2	1.50E-03	1.78E-02	1.34E-02	4.91E-02	5.28E-04	1.2395E+00	6.8340E+01
α_3	6.56E-06	5.81E-03	2.16E-03	2.40E-02	9.26E-06	4.0451E-01	6.9175E+01
α_4	1.38E-08	3.20E-03	4.38E-04	1.60E-02	0.00E+00	2.2267E-01	6.9357E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9443900	0.9719190	0.9743700	0.9910730	0.9992960	1.2312E+02	3.5572E+00
α_2	3.27E-03	1.68E-02	1.44E-02	3.89E-02	6.86E-04	2.1327E+00	1.2454E+02
α_3	3.77E-04	7.72E-03	5.33E-03	2.32E-02	1.85E-05	9.7788E-01	1.2570E+02
α_4	1.94E-06	2.96E-03	9.95E-04	1.26E-02	0.00E+00	3.7439E-01	1.2630E+02
α_5	4.71E-21	5.71E-04	3.22E-07	3.30E-03	0.00E+00	7.2277E-02	1.2660E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9471940	0.9719590	0.9739870	0.9898030	0.9991350	1.4928E+02	4.3067E+00
α_2	3.07E-03	1.48E-02	1.27E-02	3.35E-02	8.34E-04	2.2662E+00	1.5132E+02
α_3	5.24E-04	7.44E-03	5.44E-03	2.12E-02	3.09E-05	1.1428E+00	1.5244E+02
α_4	3.45E-05	3.86E-03	2.02E-03	1.39E-02	0.00E+00	5.9222E-01	1.5299E+02
α_5	6.04E-09	1.45E-03	1.96E-04	7.25E-03	0.00E+00	2.2220E-01	1.5336E+02
α_6	9.18E-19	5.42E-04	9.48E-07	3.16E-03	0.00E+00	8.3237E-02	1.5350E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9998150	0.9996290	0.9994630	0.9992960	0.9991350
α_2	1.85E-04	3.64E-04	5.28E-04	6.86E-04	8.34E-04
α_3		6.18E-06	9.26E-06	1.85E-05	3.09E-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	9.99E-01	9.99E-01	9.99E-01
Beta	1.85E-04	3.71E-04	5.37E-04	7.04E-04	8.65E-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	10.70	16.05	21.40	26.75	32.10
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

1.3.8.2 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 :	2009/12/31

Total Number of Independent Failure Events: 32.80
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9367930	0.9842450	0.9935970	0.9999690	1.0000000	2.7146E+01	4.3452E-01
α_2	2.86E-05	1.58E-02	6.41E-03	6.32E-02	0.00E+00	4.3452E-01	2.7146E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9436320	0.9803440	0.9857090	0.9987070	1.0000000	5.4905E+01	1.1009E+00
α_2	4.70E-04	1.49E-02	9.63E-03	4.72E-02	0.00E+00	8.3366E-01	5.5172E+01
α_3	1.67E-07	4.77E-03	9.60E-04	2.26E-02	0.00E+00	2.6722E-01	5.5739E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9454570	0.9773190	0.9810890	0.9962910	1.0000000	7.9936E+01	1.8551E+00
α_2	1.24E-03	1.50E-02	1.13E-02	4.16E-02	0.00E+00	1.2281E+00	8.0563E+01
α_3	5.55E-06	4.94E-03	1.83E-03	2.04E-02	0.00E+00	4.0431E-01	8.1387E+01
α_4	1.17E-08	2.72E-03	3.72E-04	1.36E-02	0.00E+00	2.2267E-01	8.1568E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9500720	0.9748520	0.9770720	0.9920540	1.0000000	1.3716E+02	3.5382E+00
α_2	2.89E-03	1.50E-02	1.28E-02	3.48E-02	0.00E+00	2.1142E+00	1.3858E+02
α_3	3.39E-04	6.95E-03	4.79E-03	2.09E-02	0.00E+00	9.7738E-01	1.3972E+02
α_4	1.75E-06	2.66E-03	8.95E-04	1.13E-02	0.00E+00	3.7439E-01	1.4032E+02
α_5	4.24E-21	5.14E-04	2.90E-07	2.97E-03	0.00E+00	7.2277E-02	1.4063E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9525870	0.9748930	0.9767320	0.9909210	1.0000000	1.6614E+02	4.2787E+00
α_2	2.69E-03	1.31E-02	1.13E-02	2.99E-02	0.00E+00	2.2392E+00	1.6818E+02
α_3	4.71E-04	6.70E-03	4.90E-03	1.91E-02	0.00E+00	1.1418E+00	1.6928E+02
α_4	3.10E-05	3.48E-03	1.82E-03	1.25E-02	0.00E+00	5.9222E-01	1.6983E+02
α_5	5.45E-09	1.30E-03	1.77E-04	6.53E-03	0.00E+00	2.2220E-01	1.7020E+02
α_6	8.27E-19	4.88E-04	8.54E-07	2.85E-03	0.00E+00	8.3237E-02	1.7034E+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	16.40	24.60	32.80	41.00	49.20
N_1	0.5000	0.7500	1.0000	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

1.3.9 Pressurizer PORV Motor-Operated Block Valves

1.3.9.1 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 :	2009/12/31

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

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	4.00	4.00	4.00
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

1.3.9.2 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 : 2009/12/31

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

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	4.00	4.00	4.00
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 Air Operated Valves

1.4.1 Pooled Air Operated Valves

1.4.1.1 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 :	2009/12/31

Total Number of Independent Failure Events: 62.30
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9293770	0.9772970	0.9849220	0.9991760	0.9842430	3.7461E+01	8.7022E-01
α_2	8.21E-04	2.27E-02	1.51E-02	7.06E-02	1.58E-02	8.7022E-01	3.7461E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9311110	0.9698620	0.9741310	0.9940140	0.9741840	6.9446E+01	2.1580E+00
α_2	3.78E-03	2.47E-02	2.04E-02	6.02E-02	2.28E-02	1.7658E+00	6.9838E+01
α_3	5.02E-06	5.48E-03	1.96E-03	2.29E-02	3.05E-03	3.9222E-01	7.1212E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9297200	0.9641440	0.9671430	0.9883180	0.9666310	9.8331E+01	3.6569E+00
α_2	6.73E-03	2.66E-02	2.36E-02	5.69E-02	2.76E-02	2.7174E+00	9.9270E+01
α_3	8.70E-05	6.42E-03	3.60E-03	2.23E-02	4.63E-03	6.5431E-01	1.0133E+02
α_4	1.87E-07	2.80E-03	6.30E-04	1.30E-02	1.16E-03	2.8517E-01	1.0170E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9372330	0.9637320	0.9655770	0.9839340	0.9625690	1.6053E+02	6.0413E+00
α_2	8.41E-03	2.42E-02	2.23E-02	4.64E-02	2.87E-02	4.0338E+00	1.6254E+02
α_3	8.36E-04	8.24E-03	6.38E-03	2.20E-02	5.92E-03	1.3732E+00	1.6520E+02
α_4	1.71E-05	3.19E-03	1.53E-03	1.20E-02	2.34E-03	5.3069E-01	1.6604E+02
α_5	1.01E-15	6.22E-04	4.55E-06	3.61E-03	4.68E-04	1.0358E-01	1.6647E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9380990	0.9624250	0.9639530	0.9815360	0.9589560	1.9326E+02	7.5454E+00
α_2	8.88E-03	2.33E-02	2.17E-02	4.30E-02	3.05E-02	4.6690E+00	1.9614E+02
α_3	1.08E-03	8.07E-03	6.51E-03	2.04E-02	6.02E-03	1.6210E+00	1.9918E+02
α_4	1.34E-04	4.19E-03	2.70E-03	1.33E-02	3.12E-03	8.4052E-01	1.9996E+02
α_5	2.69E-07	1.57E-03	4.18E-04	7.08E-03	1.18E-03	3.1600E-01	2.0049E+02
α_6	2.08E-16	4.92E-04	2.73E-06	2.86E-03	1.96E-04	9.8837E-02	2.0071E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9442730	0.9641130	0.9652010	0.9802290	0.9598720	2.7259E+02	1.0146E+01
α_2	8.21E-03	1.95E-02	1.84E-02	3.47E-02	2.64E-02	5.5252E+00	2.7721E+02
α_3	1.80E-03	8.32E-03	7.20E-03	1.87E-02	7.83E-03	2.3535E+00	2.8038E+02
α_4	4.22E-04	4.60E-03	3.50E-03	1.26E-02	3.39E-03	1.3017E+00	2.8143E+02
α_5	3.98E-05	2.43E-03	1.41E-03	8.33E-03	1.80E-03	6.8817E-01	2.8205E+02
α_6	9.49E-09	8.52E-04	1.38E-04	4.17E-03	5.93E-04	2.4098E-01	2.8250E+02
α_7	1.06E-38	1.30E-04	1.40E-11	5.96E-04	8.46E-05	3.6871E-02	2.8270E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9468780	0.9649310	0.9658610	0.9797970	0.9604320	3.1941E+02	1.1609E+01
α_2	7.68E-03	1.77E-02	1.68E-02	3.10E-02	2.40E-02	5.8657E+00	3.2515E+02
α_3	1.89E-03	7.87E-03	6.90E-03	1.72E-02	8.27E-03	2.6051E+00	3.2841E+02
α_4	5.66E-04	4.63E-03	3.68E-03	1.20E-02	3.70E-03	1.5342E+00	3.2948E+02
α_5	1.22E-04	2.83E-03	1.91E-03	8.66E-03	2.17E-03	9.3553E-01	3.3008E+02
α_6	4.39E-06	1.44E-03	6.29E-04	5.62E-03	1.05E-03	4.7676E-01	3.3054E+02
α_7	7.05E-12	4.66E-04	2.15E-05	2.55E-03	2.99E-04	1.5427E-01	3.3086E+02
α_8	1.27E-38	1.12E-04	1.30E-11	5.12E-04	3.72E-05	3.7024E-02	3.3098E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9842430	0.9741840	0.9666310	0.9625690	0.9589560	0.9598720	0.9604320
α_2	1.58E-02	2.28E-02	2.76E-02	2.87E-02	3.05E-02	2.64E-02	2.40E-02
α_3		3.05E-03	4.63E-03	5.92E-03	6.02E-03	7.83E-03	8.27E-03
α_4			1.16E-03	2.34E-03	3.12E-03	3.39E-03	3.70E-03
α_5				4.68E-04	1.18E-03	1.80E-03	2.17E-03
α_6					1.96E-04	5.93E-04	1.05E-03
α_7						8.46E-05	2.99E-04
α_8							3.72E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.84E-01	9.74E-01	9.67E-01	9.63E-01	9.59E-01	9.60E-01	9.60E-01
Beta	1.58E-02	2.58E-02	3.34E-02	3.74E-02	4.10E-02	4.01E-02	3.96E-02
Gamma		1.18E-01	1.73E-01	2.33E-01	2.56E-01	3.41E-01	3.92E-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	24.92	37.38	49.84	62.30	74.76	87.22	99.68
N_1	2.2952	2.5107	2.3548	2.0670	1.5640	1.3174	0.9958
N_2	0.4357	0.9321	1.4893	1.9196	2.4298	2.4374	2.5210
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

1.4.1.2 AOV FAIL TO OPERATE ALL SYSTEMS SPAR: AOV-FO

Component : Air Operated Valve
Failure Mode : Fail to close (reseat) on demand
Fail to open on demand
Fail to Operate (Open/Close)
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 103.60
Total Number of Common-Cause Failure Events: 7

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9453270	0.9807140	0.9858220	0.9986420	0.9854400	5.7895E+01	1.1385E+00
α_2	1.36E-03	1.93E-02	1.42E-02	5.47E-02	1.46E-02	1.1385E+00	5.7895E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9396580	0.9710240	0.9740450	0.9920680	0.9739940	9.9296E+01	2.9630E+00
α_2	6.01E-03	2.51E-02	2.21E-02	5.46E-02	2.43E-02	2.5708E+00	9.9688E+01
α_3	3.50E-06	3.84E-03	1.37E-03	1.60E-02	1.75E-03	3.9222E-01	1.0187E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9338780	0.9629920	0.9651410	0.9847550	0.9638300	1.3705E+02	5.2669E+00
α_2	1.11E-02	3.04E-02	2.82E-02	5.71E-02	3.29E-02	4.3274E+00	1.3799E+02
α_3	6.22E-05	4.60E-03	2.58E-03	1.60E-02	2.65E-03	6.5431E-01	1.4166E+02
α_4	1.34E-07	2.00E-03	4.50E-04	9.31E-03	6.63E-04	2.8517E-01	1.4203E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9395180	0.9627810	0.9642010	0.9812080	0.9613040	2.0843E+02	8.0574E+00
α_2	1.13E-02	2.64E-02	2.50E-02	4.64E-02	3.08E-02	5.7162E+00	2.1077E+02
α_3	1.14E-03	7.88E-03	6.43E-03	1.96E-02	6.25E-03	1.7069E+00	2.1478E+02
α_4	1.31E-05	2.45E-03	1.18E-03	9.21E-03	1.34E-03	5.3069E-01	2.1596E+02
α_5	7.76E-16	4.78E-04	3.50E-06	2.77E-03	2.68E-04	1.0358E-01	2.1638E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9422830	0.9632400	0.9644250	0.9801680	0.9619640	2.5073E+02	9.5686E+00
α_2	9.83E-03	2.26E-02	2.14E-02	3.95E-02	2.62E-02	5.8858E+00	2.5441E+02
α_3	1.89E-03	8.90E-03	7.68E-03	2.01E-02	8.45E-03	2.3163E+00	2.5798E+02
α_4	1.66E-04	3.66E-03	2.49E-03	1.11E-02	2.58E-03	9.5162E-01	2.5935E+02
α_5	2.07E-07	1.21E-03	3.22E-04	5.46E-03	6.74E-04	3.1600E-01	2.5998E+02
α_6	1.60E-16	3.80E-04	2.10E-06	2.21E-03	1.12E-04	9.8837E-02	2.6020E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9480130	0.9653830	0.9662600	0.9797570	0.9644580	3.3962E+02	1.2178E+01
α_2	8.26E-03	1.82E-02	1.73E-02	3.13E-02	2.06E-02	6.4141E+00	3.4538E+02
α_3	2.59E-03	9.02E-03	8.11E-03	1.86E-02	9.57E-03	3.1745E+00	3.4862E+02
α_4	5.81E-04	4.51E-03	3.61E-03	1.15E-02	3.70E-03	1.5865E+00	3.5021E+02
α_5	4.08E-05	2.06E-03	1.23E-03	6.92E-03	1.26E-03	7.2517E-01	3.5107E+02
α_6	7.62E-09	6.85E-04	1.11E-04	3.35E-03	3.39E-04	2.4098E-01	3.5156E+02
α_7	8.52E-39	1.05E-04	1.13E-11	4.79E-04	4.84E-05	3.6871E-02	3.5176E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9509310	0.9666810	0.9674360	0.9798430	0.9662690	3.9601E+02	1.3650E+01
α_2	7.27E-03	1.59E-02	1.51E-02	2.72E-02	1.73E-02	6.5236E+00	4.0314E+02
α_3	2.56E-03	8.36E-03	7.57E-03	1.68E-02	9.19E-03	3.4245E+00	4.0624E+02
α_4	8.42E-04	4.81E-03	4.03E-03	1.14E-02	4.50E-03	1.9712E+00	4.0769E+02
α_5	1.48E-04	2.56E-03	1.81E-03	7.54E-03	1.86E-03	1.0499E+00	4.0861E+02
α_6	4.18E-06	1.19E-03	5.33E-04	4.62E-03	6.66E-04	4.8906E-01	4.0917E+02
α_7	5.69E-12	3.77E-04	1.74E-05	2.06E-03	1.71E-04	1.5427E-01	4.0951E+02
α_8	1.02E-38	9.04E-05	1.05E-11	4.14E-04	2.13E-05	3.7024E-02	4.0962E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9854400	0.9739940	0.9638300	0.9613040	0.9619640	0.9644580	0.9662690
α_2	1.46E-02	2.43E-02	3.29E-02	3.08E-02	2.62E-02	2.06E-02	1.73E-02
α_3		1.75E-03	2.65E-03	6.25E-03	8.45E-03	9.57E-03	9.19E-03
α_4			6.63E-04	1.34E-03	2.58E-03	3.70E-03	4.50E-03
α_5				2.68E-04	6.74E-04	1.26E-03	1.86E-03
α_6					1.12E-04	3.39E-04	6.66E-04
α_7						4.84E-05	1.71E-04
α_8							2.13E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.85E-01	9.74E-01	9.64E-01	9.61E-01	9.62E-01	9.64E-01	9.66E-01
Beta	1.46E-02	2.60E-02	3.62E-02	3.87E-02	3.80E-02	3.55E-02	3.37E-02
Gamma		6.71E-02	9.16E-02	2.03E-01	3.11E-01	4.20E-01	4.86E-01
Delta			2.00E-01	2.05E-01	2.85E-01	3.59E-01	4.40E-01
Epsilon				1.67E-01	2.33E-01	3.08E-01	3.77E-01
Mu					1.43E-01	2.35E-01	3.15E-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	43.99	65.99	87.98	109.98	131.97	153.97	175.97
N_1	3.6586	3.7507	2.9348	2.2845	1.8163	1.6020	1.3101
N_2	0.7040	1.7371	3.0993	3.6020	3.6466	3.3263	3.1789
N_3		0.1250	0.2500	0.7295	1.1745	1.5433	1.6861
N_4			0.0625	0.1563	0.3594	0.5976	0.8247
N_5				0.0313	0.0938	0.2034	0.3416
N_6					0.0156	0.0547	0.1221
N_7						0.0078	0.0313
N_8							0.0039

1.4.1.3 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 : 2009/12/31

Total Number of Independent Failure Events: 35.80
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9182340	0.9756400	0.9854650	0.9995550	0.9852350	2.8149E+01	7.0282E-01
α_2	4.42E-04	2.44E-02	1.45E-02	8.18E-02	1.48E-02	7.0282E-01	2.8149E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9213520	0.9668540	0.9721130	0.9943400	0.9700130	5.5595E+01	1.9059E+00
α_2	3.93E-03	2.85E-02	2.32E-02	7.11E-02	3.00E-02	1.6387E+00	5.5862E+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	0.9174070	0.9583780	0.9620050	0.9869430	0.9543390	7.9786E+01	3.4651E+00
α_2	9.01E-03	3.41E-02	3.04E-02	7.17E-02	4.57E-02	2.8381E+00	8.0413E+01
α_3	5.45E-06	4.86E-03	1.80E-03	2.01E-02	0.00E+00	4.0431E-01	8.2847E+01
α_4	1.15E-08	2.67E-03	3.65E-04	1.34E-02	0.00E+00	2.2267E-01	8.3028E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9316390	0.9612330	0.9633660	0.9835490	0.9537330	1.3772E+02	5.5543E+00
α_2	8.83E-03	2.65E-02	2.43E-02	5.16E-02	3.86E-02	3.7965E+00	1.3948E+02
α_3	8.53E-04	9.15E-03	6.99E-03	2.48E-02	7.66E-03	1.3111E+00	1.4196E+02
α_4	1.72E-06	2.61E-03	8.79E-04	1.11E-02	0.00E+00	3.7439E-01	1.4290E+02
α_5	4.16E-21	5.04E-04	2.85E-07	2.92E-03	0.00E+00	7.2277E-02	1.4320E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9375990	0.9635940	0.9653710	0.9835360	0.9610060	1.6680E+02	6.3019E+00
α_2	6.18E-03	2.00E-02	1.81E-02	4.00E-02	2.35E-02	3.4560E+00	1.6965E+02
α_3	1.70E-03	1.06E-02	8.80E-03	2.57E-02	1.34E-02	1.8371E+00	1.7126E+02
α_4	7.22E-05	4.06E-03	2.38E-03	1.38E-02	2.14E-03	7.0332E-01	1.7240E+02
α_5	5.36E-09	1.28E-03	1.74E-04	6.43E-03	0.00E+00	2.2220E-01	1.7288E+02
α_6	8.14E-19	4.81E-04	8.40E-07	2.80E-03	0.00E+00	8.3237E-02	1.7302E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9455660	0.9661860	0.9674170	0.9825930	0.9662490	2.4221E+02	8.4767E+00
α_2	5.44E-03	1.59E-02	1.46E-02	3.06E-02	1.48E-02	3.9767E+00	2.4671E+02
α_3	2.21E-03	9.78E-03	8.51E-03	2.17E-02	1.36E-02	2.4522E+00	2.4823E+02
α_4	4.46E-04	5.08E-03	3.84E-03	1.40E-02	4.73E-03	1.2737E+00	2.4941E+02
α_5	1.53E-05	2.23E-03	1.11E-03	8.22E-03	6.15E-04	5.5877E-01	2.5013E+02
α_6	2.68E-10	7.43E-04	6.34E-05	3.90E-03	0.00E+00	1.8628E-01	2.5050E+02
α_7	0.00E+00	1.16E-04	1.01E-13	4.36E-04	0.00E+00	2.9071E-02	2.5066E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9492430	0.9677550	0.9688110	0.9826660	0.9702010	2.8518E+02	9.5021E+00
α_2	4.67E-03	1.36E-02	1.25E-02	2.62E-02	9.61E-03	4.0026E+00	2.9068E+02
α_3	2.05E-03	8.68E-03	7.60E-03	1.90E-02	1.20E-02	2.5579E+00	2.9212E+02
α_4	6.90E-04	5.37E-03	4.30E-03	1.37E-02	6.38E-03	1.5835E+00	2.9310E+02
α_5	8.36E-05	2.79E-03	1.78E-03	8.95E-03	1.67E-03	8.2273E-01	2.9386E+02
α_6	9.25E-07	1.29E-03	4.39E-04	5.44E-03	1.80E-04	3.7926E-01	2.9430E+02
α_7	5.52E-14	4.17E-04	7.50E-06	2.38E-03	0.00E+00	1.2297E-01	2.9456E+02
α_8	1.03E-42	1.12E-04	1.60E-12	4.75E-04	0.00E+00	3.3124E-02	2.9465E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9852350	0.9700130	0.9543390	0.9537330	0.9610060	0.9662490	0.9702010
α_2	1.48E-02	3.00E-02	4.57E-02	3.86E-02	2.35E-02	1.48E-02	9.61E-03
α_3		0.00E+00	0.00E+00	7.66E-03	1.34E-02	1.36E-02	1.20E-02
α_4			0.00E+00	0.00E+00	2.14E-03	4.73E-03	6.38E-03
α_5				0.00E+00	0.00E+00	6.15E-04	1.67E-03
α_6					0.00E+00	0.00E+00	1.80E-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	9.85E-01	9.70E-01	9.54E-01	9.54E-01	9.61E-01	9.66E-01	9.70E-01
Beta	1.48E-02	3.00E-02	4.57E-02	4.63E-02	3.90E-02	3.38E-02	2.98E-02
Gamma		0.00E+00	0.00E+00	1.66E-01	3.99E-01	5.62E-01	6.78E-01
Delta			0.00E+00	0.00E+00	1.38E-01	2.82E-01	4.08E-01
Epsilon				0.00E+00	0.00E+00	1.15E-01	2.25E-01
Mu					0.00E+00	0.00E+00	9.71E-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	16.54	24.80	33.07	41.34	49.61	57.88	66.14
N_1	1.3633	1.2400	0.5800	0.2175	0.2523	0.2845	0.3143
N_2	0.2683	0.8050	1.6100	1.6823	1.2168	0.8889	0.6579
N_3		0.0000	0.0000	0.3337	0.6953	0.8210	0.8195
N_4			0.0000	0.0000	0.1111	0.2848	0.4370
N_5				0.0000	0.0000	0.0370	0.1144
N_6					0.0000	0.0000	0.0123
N_7						0.0000	0.0000
N_8							0.0000

1.4.2 BWR Isolation Condenser Air-Operated Valves

1.4.2.1 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 :	2009/12/31

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

1.4.2.2 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 : 2009/12/31

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

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	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

1.4.3 PWR Auxiliary Feedwater Air-Operated Valves

1.4.3.1 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 : 2009/12/31

Total Number of Independent Failure Events: 28.10
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8905070	0.9658380	0.9781610	0.9990790	0.9714760	2.2248E+01	7.8692E-01
α_2	9.22E-04	3.42E-02	2.18E-02	1.09E-01	2.85E-02	7.8692E-01	2.2248E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9075050	0.9608960	0.9670320	0.9932840	0.9555020	4.6886E+01	1.9080E+00
α_2	3.80E-03	3.11E-02	2.49E-02	7.94E-02	3.76E-02	1.5158E+00	4.7278E+01
α_3	7.40E-06	8.04E-03	2.89E-03	3.35E-02	6.89E-03	3.9222E-01	4.8402E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9105050	0.9559940	0.9601770	0.9871720	0.9451800	6.8581E+01	3.1569E+00
α_2	6.34E-03	3.09E-02	2.67E-02	7.00E-02	4.17E-02	2.2174E+00	6.9520E+01
α_3	1.24E-04	9.12E-03	5.14E-03	3.17E-02	1.05E-02	6.5431E-01	7.1084E+01
α_4	2.66E-07	3.98E-03	8.97E-04	1.85E-02	2.63E-03	2.8517E-01	7.1453E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9259840	0.9583120	0.9606660	0.9826000	0.9371560	1.2355E+02	5.3747E+00
α_2	8.30E-03	2.68E-02	2.44E-02	5.35E-02	4.57E-02	3.4505E+00	1.2547E+02
α_3	9.04E-04	1.00E-02	7.61E-03	2.73E-02	1.07E-02	1.2899E+00	1.2763E+02
α_4	2.21E-05	4.12E-03	1.98E-03	1.55E-02	5.35E-03	5.3069E-01	1.2839E+02
α_5	1.30E-15	8.03E-04	5.89E-06	4.66E-03	1.07E-03	1.0358E-01	1.2882E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9273780	0.9569620	0.9589080	0.9799010	0.9298300	1.4909E+02	6.7051E+00
α_2	8.91E-03	2.57E-02	2.37E-02	4.94E-02	5.12E-02	4.0093E+00	1.5179E+02
α_3	1.05E-03	9.33E-03	7.33E-03	2.45E-02	9.04E-03	1.4543E+00	1.5434E+02
α_4	1.62E-04	5.31E-03	3.39E-03	1.70E-02	6.78E-03	8.2662E-01	1.5497E+02
α_5	3.47E-07	2.03E-03	5.39E-04	9.12E-03	2.71E-03	3.1600E-01	1.5548E+02
α_6	2.68E-16	6.34E-04	3.52E-06	3.69E-03	4.51E-04	9.8837E-02	1.5570E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9372280	0.9603590	0.9616880	0.9789610	0.9326310	2.2125E+02	9.1325E+00
α_2	8.09E-03	2.08E-02	1.95E-02	3.83E-02	4.30E-02	4.8019E+00	2.2558E+02
α_3	1.74E-03	9.14E-03	7.76E-03	2.12E-02	1.19E-02	2.1046E+00	2.2828E+02
α_4	4.73E-04	5.48E-03	4.13E-03	1.51E-02	6.85E-03	1.2623E+00	2.2912E+02
α_5	4.81E-05	2.98E-03	1.72E-03	1.02E-02	4.11E-03	6.8587E-01	2.2970E+02
α_6	1.17E-08	1.05E-03	1.70E-04	5.12E-03	1.37E-03	2.4098E-01	2.3014E+02
α_7	1.30E-38	1.60E-04	1.72E-11	7.31E-04	1.96E-04	3.6871E-02	2.3035E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9406840	0.9615800	0.9627060	0.9786220	0.9343680	2.6094E+02	1.0426E+01
α_2	7.53E-03	1.88E-02	1.76E-02	3.40E-02	3.87E-02	5.0941E+00	2.6627E+02
α_3	1.75E-03	8.39E-03	7.22E-03	1.90E-02	1.19E-02	2.2772E+00	2.6909E+02
α_4	6.06E-04	5.38E-03	4.22E-03	1.41E-02	6.94E-03	1.4599E+00	2.6991E+02
α_5	1.44E-04	3.42E-03	2.30E-03	1.05E-02	4.84E-03	9.2713E-01	2.7044E+02
α_6	5.32E-06	1.76E-03	7.66E-04	6.86E-03	2.42E-03	4.7636E-01	2.7089E+02
α_7	8.60E-12	5.68E-04	2.63E-05	3.11E-03	6.93E-04	1.5427E-01	2.7121E+02
α_8	1.55E-38	1.36E-04	1.58E-11	6.25E-04	8.63E-05	3.7024E-02	2.7133E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9714760	0.9555020	0.9451800	0.9371560	0.9298300	0.9326310	0.9343680
α_2	2.85E-02	3.76E-02	4.17E-02	4.57E-02	5.12E-02	4.30E-02	3.87E-02
α_3		6.89E-03	1.05E-02	1.07E-02	9.04E-03	1.19E-02	1.19E-02
α_4			2.63E-03	5.35E-03	6.78E-03	6.85E-03	6.94E-03
α_5				1.07E-03	2.71E-03	4.11E-03	4.84E-03
α_6					4.51E-04	1.37E-03	2.42E-03
α_7						1.96E-04	6.93E-04
α_8							8.63E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.71E-01	9.56E-01	9.45E-01	9.37E-01	9.30E-01	9.33E-01	9.34E-01
Beta	2.85E-02	4.45E-02	5.48E-02	6.28E-02	7.02E-02	6.74E-02	6.56E-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	10.54	15.82	21.09	26.36	31.63	36.90	42.18
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

1.4.3.2 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 : 2009/12/31

Total Number of Independent Failure Events: 18.60
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8979280	0.9711730	0.9843030	0.9997150	0.9835510	2.0309E+01	6.0282E-01
α_2	2.88E-04	2.88E-02	1.57E-02	1.02E-01	1.64E-02	6.0282E-01	2.0309E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9120900	0.9648990	0.9714420	0.9952830	0.9665450	4.4145E+01	1.6059E+00
α_2	2.88E-03	2.93E-02	2.27E-02	7.81E-02	3.35E-02	1.3387E+00	4.4412E+01
α_3	2.05E-07	5.84E-03	1.18E-03	2.77E-02	0.00E+00	2.6722E-01	4.5484E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9116070	0.9577300	0.9621660	0.9886820	0.9489640	6.4916E+01	2.8651E+00
α_2	6.85E-03	3.30E-02	2.85E-02	7.45E-02	5.10E-02	2.2381E+00	6.5543E+01
α_3	6.71E-06	5.96E-03	2.21E-03	2.46E-02	0.00E+00	4.0431E-01	6.7377E+01
α_4	1.42E-08	3.29E-03	4.50E-04	1.65E-02	0.00E+00	2.2267E-01	6.7558E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9321000	0.9633270	0.9657920	0.9861290	0.9585030	1.1963E+02	4.5543E+00
α_2	5.83E-03	2.25E-02	2.00E-02	4.78E-02	2.79E-02	2.7965E+00	1.2139E+02
α_3	9.85E-04	1.06E-02	8.07E-03	2.86E-02	1.36E-02	1.3111E+00	1.2287E+02
α_4	1.98E-06	3.01E-03	1.01E-03	1.28E-02	0.00E+00	3.7439E-01	1.2381E+02
α_5	4.80E-21	5.82E-04	3.29E-07	3.37E-03	0.00E+00	7.2277E-02	1.2411E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9370770	0.9647460	0.9667920	0.9854350	0.9649290	1.4509E+02	5.3019E+00
α_2	4.51E-03	1.80E-02	1.59E-02	3.86E-02	1.60E-02	2.7060E+00	1.4769E+02
α_3	1.37E-03	1.06E-02	8.48E-03	2.68E-02	1.53E-02	1.5871E+00	1.4880E+02
α_4	8.31E-05	4.68E-03	2.74E-03	1.59E-02	3.81E-03	7.0332E-01	1.4969E+02
α_5	6.17E-09	1.48E-03	2.00E-04	7.40E-03	0.00E+00	2.2220E-01	1.5017E+02
α_6	9.37E-19	5.53E-04	9.68E-07	3.23E-03	0.00E+00	8.3237E-02	1.5031E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9449300	0.9666750	0.9680550	0.9837160	0.9695360	2.1688E+02	7.4767E+00
α_2	4.66E-03	1.52E-02	1.38E-02	3.06E-02	9.64E-03	3.4142E+00	2.2094E+02
α_3	1.73E-03	9.26E-03	7.85E-03	2.16E-02	1.32E-02	2.0772E+00	2.2228E+02
α_4	4.29E-04	5.40E-03	4.02E-03	1.51E-02	6.56E-03	1.2112E+00	2.2315E+02
α_5	1.71E-05	2.49E-03	1.25E-03	9.18E-03	1.09E-03	5.5877E-01	2.2380E+02
α_6	3.00E-10	8.30E-04	7.09E-05	4.36E-03	0.00E+00	1.8628E-01	2.2417E+02
α_7	0.00E+00	1.30E-04	1.13E-13	4.88E-04	0.00E+00	2.9071E-02	2.2433E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9483110	0.9678850	0.9690600	0.9834570	0.9729950	2.5624E+02	8.5022E+00
α_2	4.29E-03	1.35E-02	1.23E-02	2.69E-02	6.12E-03	3.5808E+00	2.6116E+02
α_3	1.56E-03	8.07E-03	6.87E-03	1.87E-02	1.03E-02	2.1360E+00	2.6261E+02
α_4	6.01E-04	5.45E-03	4.27E-03	1.43E-02	7.69E-03	1.4429E+00	2.6330E+02
α_5	8.61E-05	3.05E-03	1.92E-03	9.84E-03	2.56E-03	8.0713E-01	2.6394E+02
α_6	1.03E-06	1.43E-03	4.89E-04	6.06E-03	3.19E-04	3.7926E-01	2.6436E+02
α_7	6.15E-14	4.64E-04	8.35E-06	2.64E-03	0.00E+00	1.2297E-01	2.6462E+02
α_8	1.15E-42	1.25E-04	1.78E-12	5.29E-04	0.00E+00	3.3124E-02	2.6471E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9835510	0.9665450	0.9489640	0.9585030	0.9649290	0.9695360	0.9729950
α_2	1.64E-02	3.35E-02	5.10E-02	2.79E-02	1.60E-02	9.64E-03	6.12E-03
α_3		0.00E+00	0.00E+00	1.36E-02	1.53E-02	1.32E-02	1.03E-02
α_4			0.00E+00	0.00E+00	3.81E-03	6.56E-03	7.69E-03
α_5				0.00E+00	0.00E+00	1.09E-03	2.56E-03
α_6					0.00E+00	0.00E+00	3.19E-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	9.84E-01	9.67E-01	9.49E-01	9.59E-01	9.65E-01	9.70E-01	9.73E-01
Beta	1.64E-02	3.35E-02	5.10E-02	4.15E-02	3.51E-02	3.05E-02	2.70E-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	9.30	13.95	18.60	23.25	27.90	32.55	37.20
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

1.4.4 High Pressure Coolant Injection and Reactor Core Isolation Cooling Air Operated Valves

1.4.4.1 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 :	2009/12/31

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

1.4.4.2 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 :	2009/12/31

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

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	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

1.5 Check Valves

1.5.1 Pooled Check Valves

1.5.1.1 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 :	2009/12/31

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

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

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

1.5.1.2 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 : 2009/12/31

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

1.5.1.3 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 : 2009/12/31

Total Number of Independent Failure Events: 41.50
Total Number of Common-Cause Failure Events: 6

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8258380	0.9152060	0.9233350	0.9767230	0.8948440	3.0953E+01	2.8678E+00
α_2	2.33E-02	8.48E-02	7.67E-02	1.74E-01	1.05E-01	2.8678E+00	3.0953E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8746850	0.9325620	0.9370580	0.9750670	0.9033820	5.9475E+01	4.3009E+00
α_2	1.30E-02	4.68E-02	4.21E-02	9.65E-02	6.49E-02	2.9837E+00	6.0792E+01
α_3	1.96E-03	2.07E-02	1.59E-02	5.57E-02	3.17E-02	1.3172E+00	6.2459E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8856410	0.9332760	0.9364480	0.9700700	0.9017700	8.4693E+01	6.0551E+00
α_2	1.36E-02	4.11E-02	3.77E-02	8.00E-02	5.85E-02	3.7281E+00	8.7020E+01
α_3	2.34E-03	1.77E-02	1.43E-02	4.47E-02	2.81E-02	1.6043E+00	8.9144E+01
α_4	1.57E-04	7.96E-03	4.76E-03	2.67E-02	1.17E-02	7.2267E-01	9.0025E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9073810	0.9415620	0.9434970	0.9691410	0.8976530	1.4294E+02	8.8716E+00
α_2	1.40E-02	3.42E-02	3.22E-02	6.14E-02	5.92E-02	5.1975E+00	1.4661E+02
α_3	2.99E-03	1.47E-02	1.26E-02	3.34E-02	2.40E-02	2.2274E+00	1.4958E+02
α_4	5.04E-04	7.41E-03	5.39E-03	2.12E-02	1.44E-02	1.1244E+00	1.5069E+02
α_5	4.30E-07	2.12E-03	5.81E-04	9.48E-03	4.80E-03	3.2228E-01	1.5149E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9132090	0.9436940	0.9453070	0.9686610	0.9021690	1.7227E+02	1.0279E+01
α_2	1.13E-02	2.80E-02	2.63E-02	5.06E-02	4.69E-02	5.1142E+00	1.7743E+02
α_3	4.21E-03	1.58E-02	1.41E-02	3.34E-02	2.85E-02	2.8918E+00	1.7966E+02
α_4	7.15E-04	7.35E-03	5.65E-03	1.98E-02	1.22E-02	1.3422E+00	1.8121E+02
α_5	7.73E-05	3.96E-03	2.35E-03	1.33E-02	8.15E-03	7.2220E-01	1.8183E+02
α_6	2.04E-09	1.14E-03	1.32E-04	5.82E-03	2.04E-03	2.0824E-01	1.8234E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9288810	0.9523280	0.9534770	0.9718420	0.9149660	2.4861E+02	1.2445E+01
α_2	8.37E-03	2.04E-02	1.91E-02	3.65E-02	3.15E-02	5.3128E+00	2.5574E+02
α_3	3.80E-03	1.27E-02	1.15E-02	2.58E-02	2.39E-02	3.3187E+00	2.5774E+02
α_4	1.49E-03	7.95E-03	6.74E-03	1.86E-02	1.54E-02	2.0764E+00	2.5898E+02
α_5	3.11E-04	4.39E-03	3.21E-03	1.25E-02	8.86E-03	1.1468E+00	2.5991E+02
α_6	7.44E-06	1.91E-03	8.69E-04	7.34E-03	4.43E-03	4.9878E-01	2.6056E+02
α_7	1.44E-17	3.51E-04	1.20E-06	2.05E-03	8.86E-04	9.1571E-02	2.6096E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9352050	0.9560050	0.9569940	0.9734230	0.9247920	2.9251E+02	1.3461E+01
α_2	6.64E-03	1.66E-02	1.56E-02	3.01E-02	2.17E-02	5.0778E+00	3.0089E+02
α_3	3.29E-03	1.09E-02	9.90E-03	2.22E-02	2.02E-02	3.3478E+00	3.0262E+02
α_4	1.61E-03	7.57E-03	6.53E-03	1.71E-02	1.47E-02	2.3159E+00	3.0366E+02
α_5	5.86E-04	4.93E-03	3.90E-03	1.28E-02	1.00E-02	1.5089E+00	3.0446E+02
α_6	8.58E-05	2.73E-03	1.75E-03	8.71E-03	5.88E-03	8.3576E-01	3.0514E+02
α_7	1.48E-07	1.01E-03	2.62E-04	4.59E-03	2.35E-03	3.1047E-01	3.0566E+02
α_8	1.24E-23	2.11E-04	4.11E-08	1.20E-03	3.92E-04	6.4424E-02	3.0591E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.8948440	0.9033820	0.9017700	0.8976530	0.9021690	0.9149660	0.9247920
α_2	1.05E-01	6.49E-02	5.85E-02	5.92E-02	4.69E-02	3.15E-02	2.17E-02
α_3		3.17E-02	2.81E-02	2.40E-02	2.85E-02	2.39E-02	2.02E-02
α_4			1.17E-02	1.44E-02	1.22E-02	1.54E-02	1.47E-02
α_5				4.80E-03	8.15E-03	8.86E-03	1.00E-02
α_6					2.04E-03	4.43E-03	5.88E-03
α_7						8.86E-04	2.35E-03
α_8							3.92E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	8.95E-01	9.03E-01	9.02E-01	8.98E-01	9.02E-01	9.15E-01	9.25E-01
Beta	1.05E-01	9.66E-02	9.82E-02	1.02E-01	9.78E-02	8.50E-02	7.52E-02
Gamma		3.28E-01	4.05E-01	4.22E-01	5.21E-01	6.29E-01	7.11E-01
Delta			2.94E-01	4.44E-01	4.40E-01	5.53E-01	6.23E-01
Epsilon				2.50E-01	4.55E-01	4.79E-01	5.60E-01
Mu					2.00E-01	3.75E-01	4.62E-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	18.44	27.67	36.89	46.11	55.33	64.56	73.78
N_1	2.2667	2.2500	1.6667	0.6667	0.0000	0.0000	0.0000
N_2	2.4333	2.1500	2.5000	3.0833	2.8750	2.2250	1.7331
N_3		1.0500	1.2000	1.2500	1.7500	1.6875	1.6094
N_4			0.5000	0.7500	0.7500	1.0875	1.1694
N_5				0.2500	0.5000	0.6250	0.8006
N_6					0.1250	0.3125	0.4688
N_7						0.0625	0.1875
N_8							0.0313

1.5.1.4 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 : 2009/12/31

Total Number of Independent Failure Events: 34.00
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8631670	0.9467440	0.9573700	0.9938780	0.9385750	2.5679E+01	1.4445E+00
α_2	6.12E-03	5.33E-02	4.26E-02	1.37E-01	6.14E-02	1.4445E+00	2.5679E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9111470	0.9611330	0.9666100	0.9923520	0.9573830	5.2680E+01	2.1303E+00
α_2	2.52E-03	2.49E-02	1.93E-02	6.61E-02	2.19E-02	1.3628E+00	5.3448E+01
α_3	3.41E-04	1.40E-02	8.69E-03	4.58E-02	2.07E-02	7.6752E-01	5.4043E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9238860	0.9635160	0.9673230	0.9901170	0.9667880	7.6925E+01	2.9128E+00
α_2	2.38E-03	1.92E-02	1.54E-02	4.92E-02	9.63E-03	1.5347E+00	7.8303E+01
α_3	4.53E-04	1.13E-02	7.60E-03	3.50E-02	1.57E-02	9.0541E-01	7.8932E+01
α_4	1.73E-05	5.92E-03	2.58E-03	2.31E-02	7.85E-03	4.7267E-01	7.9365E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9385930	0.9667300	0.9689460	0.9873020	0.9723240	1.3461E+02	4.6326E+00
α_2	3.60E-03	1.67E-02	1.45E-02	3.76E-02	5.47E-03	2.3306E+00	1.3691E+02
α_3	9.65E-04	9.73E-03	7.51E-03	2.61E-02	9.56E-03	1.3553E+00	1.3789E+02
α_4	1.20E-04	5.38E-03	3.27E-03	1.78E-02	9.48E-03	7.4939E-01	1.3849E+02
α_5	1.19E-09	1.42E-03	1.42E-04	7.33E-03	3.16E-03	1.9728E-01	1.3905E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9428380	0.9678380	0.9696720	0.9865660	0.9758840	1.6302E+02	5.4173E+00
α_2	3.25E-03	1.45E-02	1.26E-02	3.21E-02	4.14E-03	2.4346E+00	1.6600E+02
α_3	8.68E-04	8.30E-03	6.45E-03	2.20E-02	5.42E-03	1.3975E+00	1.6704E+02
α_4	2.72E-04	5.74E-03	3.94E-03	1.74E-02	7.94E-03	9.6722E-01	1.6747E+02
α_5	8.11E-06	2.80E-03	1.21E-03	1.10E-02	5.30E-03	4.7220E-01	1.6797E+02
α_6	4.43E-12	8.65E-04	3.23E-05	4.79E-03	1.32E-03	1.4574E-01	1.6829E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9487750	0.9688850	0.9701490	0.9846690	0.9783170	2.3775E+02	7.6352E+00
α_2	4.00E-03	1.34E-02	1.21E-02	2.73E-02	3.85E-03	3.2991E+00	2.4209E+02
α_3	1.14E-03	7.33E-03	6.04E-03	1.79E-02	3.03E-03	1.7975E+00	2.4359E+02
α_4	4.86E-04	5.30E-03	4.03E-03	1.45E-02	5.69E-03	1.3014E+00	2.4408E+02
α_5	1.06E-04	3.40E-03	2.18E-03	1.08E-02	5.69E-03	8.3427E-01	2.4455E+02
α_6	4.66E-07	1.40E-03	4.17E-04	6.11E-03	2.85E-03	3.4258E-01	2.4504E+02
α_7	6.77E-25	2.46E-04	2.48E-08	1.38E-03	5.70E-04	6.0371E-02	2.4532E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9517130	0.9698750	0.9709520	0.9843510	0.9802170	2.8004E+02	8.6984E+00
α_2	3.92E-03	1.24E-02	1.13E-02	2.46E-02	3.72E-03	3.5771E+00	2.8516E+02
α_3	1.04E-03	6.41E-03	5.32E-03	1.55E-02	1.82E-03	1.8521E+00	2.8689E+02
α_4	4.89E-04	4.78E-03	3.70E-03	1.28E-02	3.76E-03	1.3815E+00	2.8736E+02
α_5	1.91E-04	3.54E-03	2.48E-03	1.05E-02	5.00E-03	1.0208E+00	2.8772E+02
α_6	1.98E-05	2.08E-03	1.10E-03	7.48E-03	3.75E-03	6.0136E-01	2.8814E+02
α_7	2.28E-09	7.51E-04	9.57E-05	3.79E-03	1.50E-03	2.1677E-01	2.8852E+02
α_8	4.02E-30	1.69E-04	1.34E-09	8.90E-04	2.49E-04	4.8724E-02	2.8869E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9385750	0.9573830	0.9667880	0.9723240	0.9758840	0.9783170	0.9802170
α_2	6.14E-02	2.19E-02	9.63E-03	5.47E-03	4.14E-03	3.85E-03	3.72E-03
α_3		2.07E-02	1.57E-02	9.56E-03	5.42E-03	3.03E-03	1.82E-03
α_4			7.85E-03	9.48E-03	7.94E-03	5.69E-03	3.76E-03
α_5				3.16E-03	5.30E-03	5.69E-03	5.00E-03
α_6					1.32E-03	2.85E-03	3.75E-03
α_7						5.70E-04	1.50E-03
α_8							2.49E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.39E-01	9.57E-01	9.67E-01	9.72E-01	9.76E-01	9.78E-01	9.80E-01
Beta	6.14E-02	4.26E-02	3.32E-02	2.77E-02	2.41E-02	2.17E-02	1.98E-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	15.11	22.67	30.22	37.78	45.33	52.89	60.44
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

1.5.2 BWR Residual Heat Removal Check Valves

1.5.2.1 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 : 2009/12/31

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

1.5.2.2 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 :	2009/12/31

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

1.5.3 PWR Auxiliary Feedwater Check Valves

1.5.3.1 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 :	2009/12/31

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

1.5.3.2 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 : 2009/12/31

Total Number of Independent Failure Events: 4.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8558670	0.9634250	0.9843130	0.9999230	0.9932110	1.1709E+01	4.4452E-01
α_2	7.88E-05	3.66E-02	1.57E-02	1.44E-01	6.79E-03	4.4452E-01	1.1709E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9029900	0.9655930	0.9745390	0.9975700	0.9866030	3.1720E+01	1.1303E+00
α_2	9.30E-04	2.63E-02	1.74E-02	8.18E-02	1.33E-02	8.6276E-01	3.1988E+01
α_3	2.90E-07	8.14E-03	1.65E-03	3.86E-02	1.37E-04	2.6752E-01	3.2583E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9111300	0.9624270	0.9683240	0.9935330	0.9802180	4.8995E+01	1.9128E+00
α_2	2.29E-03	2.52E-02	1.93E-02	6.84E-02	1.94E-02	1.2847E+00	4.9623E+01
α_3	9.16E-06	7.96E-03	2.97E-03	3.28E-02	3.77E-04	4.0541E-01	5.0502E+01
α_4	1.89E-08	4.37E-03	6.00E-04	2.19E-02	0.00E+00	2.2267E-01	5.0685E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9309460	0.9648420	0.9678000	0.9886060	0.9739500	9.9687E+01	3.6325E+00
α_2	4.32E-03	2.13E-02	1.83E-02	4.87E-02	2.52E-02	2.2056E+00	1.0111E+02
α_3	4.67E-04	9.49E-03	6.57E-03	2.85E-02	8.01E-04	9.8028E-01	1.0234E+02
α_4	2.38E-06	3.62E-03	1.22E-03	1.54E-02	0.00E+00	3.7439E-01	1.0295E+02
α_5	5.78E-21	7.00E-04	3.96E-07	4.05E-03	0.00E+00	7.2277E-02	1.0325E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9343170	0.9648130	0.9672600	0.9869530	0.9678740	1.2112E+02	4.4173E+00
α_2	4.14E-03	1.89E-02	1.64E-02	4.22E-02	3.08E-02	2.3721E+00	1.2317E+02
α_3	6.51E-04	9.14E-03	6.70E-03	2.60E-02	1.32E-03	1.1475E+00	1.2439E+02
α_4	4.22E-05	4.72E-03	2.47E-03	1.70E-02	0.00E+00	5.9222E-01	1.2495E+02
α_5	7.40E-09	1.77E-03	2.40E-04	8.87E-03	0.00E+00	2.2220E-01	1.2532E+02
α_6	1.12E-18	6.63E-04	1.16E-06	3.87E-03	0.00E+00	8.3237E-02	1.2545E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9424460	0.9660610	0.9676370	0.9842810	0.9620000	1.8886E+02	6.6350E+00
α_2	4.94E-03	1.67E-02	1.51E-02	3.40E-02	3.60E-02	3.2678E+00	1.9223E+02
α_3	1.14E-03	8.40E-03	6.79E-03	2.11E-02	2.00E-03	1.6412E+00	1.9385E+02
α_4	2.54E-04	5.06E-03	3.50E-03	1.52E-02	0.00E+00	9.8887E-01	1.9451E+02
α_5	1.31E-05	2.67E-03	1.26E-03	1.01E-02	0.00E+00	5.2177E-01	1.9497E+02
α_6	3.44E-10	9.53E-04	8.14E-05	5.00E-03	0.00E+00	1.8628E-01	1.9531E+02
α_7	0.00E+00	1.49E-04	1.30E-13	5.60E-04	0.00E+00	2.9071E-02	1.9547E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9454720	0.9667990	0.9681350	0.9835730	0.9582140	2.2417E+02	7.6983E+00
α_2	4.86E-03	1.54E-02	1.40E-02	3.05E-02	3.82E-02	3.5615E+00	2.2831E+02
α_3	1.14E-03	7.58E-03	6.22E-03	1.87E-02	3.50E-03	1.7583E+00	2.3011E+02
α_4	3.51E-04	4.95E-03	3.62E-03	1.41E-02	1.06E-04	1.1471E+00	2.3072E+02
α_5	5.56E-05	3.05E-03	1.80E-03	1.03E-02	0.00E+00	7.0833E-01	2.3116E+02
α_6	8.96E-07	1.58E-03	5.18E-04	6.77E-03	0.00E+00	3.6696E-01	2.3150E+02
α_7	7.02E-14	5.30E-04	9.54E-06	3.02E-03	0.00E+00	1.2297E-01	2.3175E+02
α_8	1.32E-42	1.43E-04	2.04E-12	6.04E-04	0.00E+00	3.3124E-02	2.3184E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9932110	0.9866030	0.9802180	0.9739500	0.9678740	0.9620000	0.9582140
α_2	6.79E-03	1.33E-02	1.94E-02	2.52E-02	3.08E-02	3.60E-02	3.82E-02
α_3		1.37E-04	3.77E-04	8.01E-04	1.32E-03	2.00E-03	3.50E-03
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-04
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	9.87E-01	9.80E-01	9.74E-01	9.68E-01	9.62E-01	9.58E-01
Beta	6.79E-03	1.34E-02	1.98E-02	2.60E-02	3.21E-02	3.80E-02	4.18E-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	1.14	1.71	2.29	2.86	3.43	4.00	4.57
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

1.5.4 PWR High Pressure Safety Injection Check Valves

1.5.4.1 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 : 2009/12/31

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

1.5.4.2 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 : 2009/12/31

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

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	7.50	7.50	7.50	7.50	7.50
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

1.5.5 PWR Residual Heat Removal Check Valves

1.5.5.1 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 :	2009/12/31

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

1.5.5.2 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 : 2009/12/31

Total Number of Independent Failure Events: 6.50
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8989610	0.9747090	0.9895680	0.9999500	1.0000000	1.6746E+01	4.3452E-01
α_2	4.66E-05	2.53E-02	1.04E-02	1.01E-01	0.00E+00	4.3452E-01	1.6746E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9154810	0.9703710	0.9783290	0.9980400	1.0000000	3.6055E+01	1.1009E+00
α_2	7.15E-04	2.24E-02	1.46E-02	7.09E-02	0.00E+00	8.3366E-01	3.6322E+01
α_3	2.53E-07	7.19E-03	1.45E-03	3.41E-02	0.00E+00	2.6722E-01	3.6889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9185670	0.9659560	0.9714920	0.9943870	1.0000000	5.2636E+01	1.8551E+00
α_2	1.87E-03	2.25E-02	1.70E-02	6.21E-02	0.00E+00	1.2281E+00	5.3263E+01
α_3	8.37E-06	7.42E-03	2.76E-03	3.06E-02	0.00E+00	4.0431E-01	5.4087E+01
α_4	1.77E-08	4.09E-03	5.60E-04	2.05E-02	0.00E+00	2.2267E-01	5.4268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9340530	0.9666830	0.9695720	0.9894240	1.0000000	1.0266E+02	3.5382E+00
α_2	3.84E-03	1.99E-02	1.70E-02	4.60E-02	0.00E+00	2.1142E+00	1.0408E+02
α_3	4.50E-04	9.20E-03	6.36E-03	2.77E-02	0.00E+00	9.7738E-01	1.0522E+02
α_4	2.32E-06	3.53E-03	1.19E-03	1.50E-02	0.00E+00	3.7439E-01	1.0582E+02
α_5	5.62E-21	6.81E-04	3.85E-07	3.94E-03	0.00E+00	7.2277E-02	1.0613E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9369200	0.9664990	0.9689110	0.9878400	1.0000000	1.2344E+02	4.2787E+00
α_2	3.60E-03	1.75E-02	1.51E-02	3.98E-02	0.00E+00	2.2392E+00	1.2548E+02
α_3	6.30E-04	8.94E-03	6.54E-03	2.55E-02	0.00E+00	1.1418E+00	1.2658E+02
α_4	4.15E-05	4.64E-03	2.43E-03	1.67E-02	0.00E+00	5.9222E-01	1.2713E+02
α_5	7.27E-09	1.74E-03	2.36E-04	8.72E-03	0.00E+00	2.2220E-01	1.2750E+02
α_6	1.10E-18	6.52E-04	1.14E-06	3.80E-03	0.00E+00	8.3237E-02	1.2764E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9441390	0.9672830	0.9688570	0.9850630	1.0000000	1.9055E+02	6.4450E+00
α_2	4.42E-03	1.57E-02	1.41E-02	3.24E-02	0.00E+00	3.0878E+00	1.9391E+02
α_3	1.12E-03	8.28E-03	6.69E-03	2.09E-02	0.00E+00	1.6312E+00	1.9536E+02
α_4	2.52E-04	5.02E-03	3.48E-03	1.51E-02	0.00E+00	9.8887E-01	1.9601E+02
α_5	1.30E-05	2.65E-03	1.25E-03	1.00E-02	0.00E+00	5.2177E-01	1.9647E+02
α_6	3.41E-10	9.46E-04	8.07E-05	4.96E-03	0.00E+00	1.8628E-01	1.9681E+02
α_7	0.00E+00	1.48E-04	1.29E-13	5.56E-04	0.00E+00	2.9071E-02	1.9697E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9469720	0.9679360	0.9692720	0.9843530	1.0000000	2.2523E+02	7.4610E+00
α_2	4.32E-03	1.44E-02	1.30E-02	2.91E-02	0.00E+00	3.3447E+00	2.2935E+02
α_3	1.11E-03	7.47E-03	6.11E-03	1.85E-02	0.00E+00	1.7384E+00	2.3095E+02
α_4	3.49E-04	4.93E-03	3.60E-03	1.40E-02	0.00E+00	1.1465E+00	2.3154E+02
α_5	5.54E-05	3.04E-03	1.79E-03	1.03E-02	0.00E+00	7.0833E-01	2.3198E+02
α_6	8.93E-07	1.58E-03	5.16E-04	6.75E-03	0.00E+00	3.6696E-01	2.3232E+02
α_7	7.00E-14	5.28E-04	9.50E-06	3.01E-03	0.00E+00	1.2297E-01	2.3257E+02
α_8	1.31E-42	1.42E-04	2.03E-12	6.02E-04	0.00E+00	3.3124E-02	2.3266E+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	6.50	6.50	6.50	6.50	6.50	6.50	6.50
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

1.5.6 BWR High Pressure Coolant Injection/Reactor Core Isolation Cooling Check Valves

1.5.6.1 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 :	2009/12/31

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

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	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

1.5.6.2 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 :	2009/12/31

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

COMBINED HPCI AND RCIC CHECK 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	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 Strainers, Trash Racks, and Filters

1.6.1 Pooled Strainers (Non-ESW)

1.6.1.1 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/strainer
Start Date :	1997/01/01
Data Version :	2009/12/31

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	0.9939490	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	0.9939490	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	0.9939490	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	0.9939490	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	0.9939490	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	0.9939490	0.9939490	0.9939490	0.9939490	0.9939490
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

1.6.2 Emergency Service Water Strainers

1.6.2.1 SERVICE WATER TSA FTO NON ENVIRONMENTAL SPAR:TSA-FO

System :	Normally operating service water Standby service water
Component :	Strainer
Failure Mode :	Fail to Operate (Open/Close)
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/Wear Accidental human action Human action procedure Other Internal environment Internal to component, piece-part
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 28.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9304640	0.9824180	0.9925600	0.9999570	0.9988850	2.5213E+01	4.5122E-01
α_2	4.01E-05	1.76E-02	7.44E-03	6.95E-02	1.11E-03	4.5122E-01	2.5213E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9388740	0.9783290	0.9839890	0.9984260	0.9977730	5.1955E+01	1.1509E+00
α_2	6.25E-04	1.66E-02	1.11E-02	5.16E-02	2.23E-03	8.8366E-01	5.2222E+01
α_3	1.76E-07	5.03E-03	1.01E-03	2.39E-02	0.00E+00	2.6722E-01	5.2839E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9407000	0.9749000	0.9788490	0.9955910	0.9966560	7.5936E+01	1.9551E+00
α_2	1.64E-03	1.71E-02	1.31E-02	4.59E-02	3.34E-03	1.3281E+00	7.6563E+01
α_3	5.83E-06	5.19E-03	1.92E-03	2.14E-02	0.00E+00	4.0431E-01	7.7487E+01
α_4	1.23E-08	2.86E-03	3.91E-04	1.43E-02	0.00E+00	2.2267E-01	7.7668E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9470910	0.9730130	0.9752850	0.9911730	0.9957140	1.3334E+02	3.6982E+00
α_2	3.46E-03	1.66E-02	1.43E-02	3.75E-02	4.20E-03	2.2709E+00	1.3477E+02
α_3	3.52E-04	7.16E-03	4.95E-03	2.15E-02	8.84E-05	9.8068E-01	1.3606E+02
α_4	1.79E-06	2.73E-03	9.19E-04	1.16E-02	0.00E+00	3.7439E-01	1.3666E+02
α_5	4.35E-21	5.27E-04	2.98E-07	3.05E-03	0.00E+00	7.2277E-02	1.3697E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9493950	0.9728200	0.9747010	0.9898230	0.9948070	1.6146E+02	4.5111E+00
α_2	3.38E-03	1.48E-02	1.29E-02	3.28E-02	5.00E-03	2.4631E+00	1.6351E+02
α_3	4.95E-04	6.93E-03	5.08E-03	1.97E-02	1.88E-04	1.1502E+00	1.6482E+02
α_4	3.19E-05	3.57E-03	1.87E-03	1.29E-02	2.23E-06	5.9232E-01	1.6538E+02
α_5	5.59E-09	1.34E-03	1.81E-04	6.71E-03	0.00E+00	2.2220E-01	1.6575E+02
α_6	8.49E-19	5.02E-04	8.77E-07	2.93E-03	0.00E+00	8.3237E-02	1.6589E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9988850	0.9977730	0.9966560	0.9957140	0.9948070
α_2	1.11E-03	2.23E-03	3.34E-03	4.20E-03	5.00E-03
α_3		0.00E+00	0.00E+00	8.84E-05	1.88E-04
α_4			0.00E+00	0.00E+00	2.23E-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	9.96E-01	9.95E-01
Beta	1.11E-03	2.23E-03	3.34E-03	4.29E-03	5.19E-03
Gamma		0.00E+00	0.00E+00	2.06E-02	3.66E-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	14.00	21.00	28.00	35.00	42.00
N_1	0.9667	1.4000	1.8000	2.1750	2.5230
N_2	0.0167	0.0500	0.1000	0.1567	0.2239
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

1.6.2.2 SERVICE WATER TSA PLUG NON ENVIRONMENTAL SPAR:TSA-PG

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/Wear
	Accidental human action
	Human action procedure
	Other
	Internal environment
	Internal to component, piece-part
Start Date :	1997/01/01
Data Version :	2009/12/31

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 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 filter/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/Wear
	Accidental human action
	Human action procedure
	Other
	Internal environment
	Internal to component, piece-part
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 37.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9633370	0.9908870	0.9963330	0.9999820	1.0000000	4.7246E+01	4.3452E-01
α_2	1.63E-05	9.11E-03	3.67E-03	3.67E-02	0.00E+00	4.3452E-01	4.7246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9532560	0.9837280	0.9881890	0.9989340	1.0000000	6.6555E+01	1.1009E+00
α_2	3.88E-04	1.23E-02	7.96E-03	3.91E-02	0.00E+00	8.3366E-01	6.6822E+01
α_3	1.38E-07	3.95E-03	7.93E-04	1.87E-02	0.00E+00	2.6722E-01	6.7389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9474900	0.9781730	0.9818070	0.9964330	1.0000000	8.3136E+01	1.8551E+00
α_2	1.19E-03	1.44E-02	1.09E-02	4.00E-02	0.00E+00	1.2281E+00	8.3763E+01
α_3	5.34E-06	4.76E-03	1.76E-03	1.97E-02	0.00E+00	4.0431E-01	8.4587E+01
α_4	1.13E-08	2.62E-03	3.58E-04	1.31E-02	0.00E+00	2.2267E-01	8.4768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9486250	0.9741160	0.9763980	0.9918180	1.0000000	1.3316E+02	3.5382E+00
α_2	2.97E-03	1.55E-02	1.32E-02	3.58E-02	0.00E+00	2.1142E+00	1.3458E+02
α_3	3.49E-04	7.15E-03	4.93E-03	2.15E-02	0.00E+00	9.7738E-01	1.3572E+02
α_4	1.80E-06	2.74E-03	9.22E-04	1.16E-02	0.00E+00	3.7439E-01	1.3632E+02
α_5	4.36E-21	5.29E-04	2.99E-07	3.06E-03	0.00E+00	7.2277E-02	1.3663E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9489700	0.9729570	0.9749300	0.9902120	1.0000000	1.5394E+02	4.2787E+00
α_2	2.90E-03	1.42E-02	1.22E-02	3.22E-02	0.00E+00	2.2392E+00	1.5598E+02
α_3	5.07E-04	7.22E-03	5.27E-03	2.06E-02	0.00E+00	1.1418E+00	1.5708E+02
α_4	3.34E-05	3.74E-03	1.96E-03	1.35E-02	0.00E+00	5.9222E-01	1.5763E+02
α_5	5.87E-09	1.40E-03	1.90E-04	7.04E-03	0.00E+00	2.2220E-01	1.5800E+02
α_6	8.91E-19	5.26E-04	9.20E-07	3.07E-03	0.00E+00	8.3237E-02	1.5814E+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	37.00	37.00	37.00	37.00	37.00
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

1.6.3 Pooled Sump Strainers

1.6.3.1 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 :	2009/12/31

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

1.6.4 PWR Containment Sump Strainers

1.6.4.1 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 :	2009/12/31

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

1.6.5 BWR Suppression Pool Strainers

1.6.5.1 BWR RHR SUMP STRAINER PLUG

System :	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 :	2009/12/31

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

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	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

1.6.6 Extreme Environmental Event CCF Distributions

1.6.6.1 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
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 22.00
Total Number of Common-Cause Failure Events: 17

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.5941800	0.7212010	0.7252630	0.8343090	0.6231850	2.6414E+01	1.0211E+01
α_2	1.66E-01	2.79E-01	2.75E-01	4.06E-01	3.77E-01	1.0211E+01	2.6414E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.6957890	0.7858650	0.7889510	0.8653820	0.6114540	4.8709E+01	1.3272E+01
α_2	4.29E-02	9.56E-02	9.13E-02	1.63E-01	1.63E-01	5.9266E+00	5.6055E+01
α_3	5.92E-02	1.19E-01	1.14E-01	1.92E-01	2.26E-01	7.3458E+00	5.4636E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.7345000	0.8083050	0.8107290	0.8738180	0.6095610	6.8662E+01	1.6284E+01
α_2	3.56E-02	7.64E-02	7.31E-02	1.29E-01	1.42E-01	6.4924E+00	7.8453E+01
α_3	2.91E-02	6.69E-02	6.35E-02	1.16E-01	1.43E-01	5.6853E+00	7.9260E+01
α_4	1.72E-02	4.83E-02	4.48E-02	9.15E-02	1.05E-01	4.1060E+00	8.0840E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8161210	0.8657800	0.8675010	0.9095760	0.6331790	1.2296E+02	1.9062E+01
α_2	1.82E-02	4.15E-02	3.94E-02	7.21E-02	8.93E-02	5.8940E+00	1.3613E+02
α_3	2.13E-02	4.62E-02	4.40E-02	7.82E-02	1.32E-01	6.5548E+00	1.3547E+02
α_4	1.26E-02	3.29E-02	3.07E-02	6.05E-02	1.01E-01	4.6661E+00	1.3736E+02
α_5	2.38E-03	1.37E-02	1.15E-02	3.26E-02	4.43E-02	1.9473E+00	1.4007E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8364060	0.8798650	0.8813680	0.9181990	0.6637240	1.4852E+02	2.0279E+01
α_2	9.24E-03	2.55E-02	2.36E-02	4.80E-02	4.33E-02	4.2997E+00	1.6450E+02
α_3	1.73E-02	3.80E-02	3.61E-02	6.48E-02	1.11E-01	6.4077E+00	1.6239E+02
α_4	1.40E-02	3.30E-02	3.12E-02	5.83E-02	1.05E-01	5.5783E+00	1.6322E+02
α_5	4.81E-03	1.76E-02	1.57E-02	3.68E-02	5.78E-02	2.9722E+00	1.6583E+02
α_6	3.28E-04	6.05E-03	4.24E-03	1.79E-02	1.97E-02	1.0207E+00	1.6778E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.6231850	0.6114540	0.6095610	0.6331790	0.6637240
α_2	3.77E-01	1.63E-01	1.42E-01	8.93E-02	4.33E-02
α_3		2.26E-01	1.43E-01	1.32E-01	1.11E-01
α_4			1.05E-01	1.01E-01	1.05E-01
α_5				4.43E-02	5.78E-02
α_6					1.97E-02

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	6.23E-01	6.11E-01	6.10E-01	6.33E-01	6.64E-01
Beta	3.77E-01	3.89E-01	3.90E-01	3.67E-01	3.36E-01
Gamma		5.82E-01	6.35E-01	7.57E-01	8.71E-01
Delta			4.24E-01	5.25E-01	6.22E-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	10.53	15.79	21.05	26.32	31.58
N_1	5.6381	3.3643	1.4762	0.4762	0.0000
N_2	9.7762	5.0929	5.2643	3.7798	2.0605
N_3		7.0786	5.2810	5.5774	5.2659
N_4			3.8833	4.2917	4.9861
N_5				1.8750	2.7500
N_6					0.9375

1.6.6.2 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/Wear Accidental human action Human action procedure Other Internal environment Internal to component, piece-part Unknown
Start Date :	1997/01/01
Data Version :	2009/12/31

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

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	6.00	6.00	6.00	6.00	6.00
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

1.6.6.3 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 filter/strainer
Prox. Cause :	Extreme environmental stress
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 21.50
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8709670	0.9499780	0.9600910	0.9943320	0.9444340	2.7243E+01	1.4345E+00
α_2	5.67E-03	5.00E-02	3.99E-02	1.29E-01	5.56E-02	1.4345E+00	2.7243E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8799610	0.9392060	0.9443380	0.9808800	0.9096790	5.3055E+01	3.4342E+00
α_2	1.34E-02	5.02E-02	4.49E-02	1.05E-01	7.74E-02	2.8337E+00	5.3656E+01
α_3	1.02E-04	1.06E-02	5.66E-03	3.80E-02	1.29E-02	6.0052E-01	5.5889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8964060	0.9435120	0.9471170	0.9783030	0.9179890	7.6917E+01	4.6050E+00
α_2	8.26E-03	3.30E-02	2.92E-02	7.05E-02	4.35E-02	2.6864E+00	7.8836E+01
α_3	2.09E-03	1.81E-02	1.43E-02	4.70E-02	3.19E-02	1.4737E+00	8.0048E+01
α_4	1.12E-05	5.46E-03	2.24E-03	2.18E-02	6.63E-03	4.4487E-01	8.1077E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9199240	0.9526280	0.9547810	0.9779870	0.9229340	1.3297E+02	6.6123E+00
α_2	6.95E-03	2.34E-02	2.12E-02	4.75E-02	2.89E-02	3.2681E+00	1.3631E+02
α_3	2.86E-03	1.50E-02	1.28E-02	3.49E-02	2.81E-02	2.0978E+00	1.3748E+02
α_4	4.04E-04	7.35E-03	5.17E-03	2.17E-02	1.63E-02	1.0260E+00	1.3856E+02
α_5	5.95E-09	1.58E-03	2.10E-04	7.93E-03	3.71E-03	2.2038E-01	1.3936E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9257860	0.9547680	0.9565620	0.9776260	0.9292550	1.6080E+02	7.6179E+00
α_2	5.62E-03	1.92E-02	1.73E-02	3.91E-02	2.10E-02	3.2302E+00	1.6519E+02
α_3	2.45E-03	1.27E-02	1.08E-02	2.93E-02	2.10E-02	2.1309E+00	1.6629E+02
α_4	9.13E-04	8.45E-03	6.60E-03	2.23E-02	1.76E-02	1.4235E+00	1.6699E+02
α_5	5.13E-05	3.87E-03	2.16E-03	1.35E-02	9.09E-03	6.5130E-01	1.6777E+02
α_6	2.74E-10	1.08E-03	8.63E-05	5.71E-03	2.09E-03	1.8204E-01	1.6824E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9444340	0.9096790	0.9179890	0.9229340	0.9292550
α_2	5.56E-02	7.74E-02	4.35E-02	2.89E-02	2.10E-02
α_3		1.29E-02	3.19E-02	2.81E-02	2.10E-02
α_4			6.63E-03	1.63E-02	1.76E-02
α_5				3.71E-03	9.09E-03
α_6					2.09E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.44E-01	9.10E-01	9.18E-01	9.23E-01	9.29E-01
Beta	5.56E-02	9.03E-02	8.20E-02	7.71E-02	7.07E-02
Gamma		1.43E-01	4.70E-01	6.25E-01	7.03E-01
Delta			1.72E-01	4.16E-01	5.79E-01
Epsilon				1.85E-01	3.88E-01
Mu					1.87E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	14.33	21.50	28.67	35.83	43.00
N_1	2.6667	2.0000	2.1111	0.9838	0.8623
N_2	1.0000	2.0000	1.4583	1.1539	0.9910
N_3		0.3333	1.0694	1.1204	0.9891
N_4			0.2222	0.6516	0.8313
N_5				0.1481	0.4291
N_6					0.0988

1.6.6.4 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
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 27.00
Total Number of Common-Cause Failure Events: 18

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.6195240	0.7394500	0.7435090	0.8454920	0.6584530	2.9334E+01	1.0336E+01
α_2	1.55E-01	2.61E-01	2.56E-01	3.80E-01	3.42E-01	1.0336E+01	2.9334E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.7096980	0.7953870	0.7983680	0.8708970	0.6506720	5.2808E+01	1.3585E+01
α_2	4.29E-02	9.35E-02	8.94E-02	1.58E-01	1.50E-01	6.2078E+00	6.0185E+01
α_3	5.54E-02	1.11E-01	1.07E-01	1.80E-01	1.99E-01	7.3770E+00	5.9016E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.7443840	0.8148940	0.8172170	0.8774700	0.6502190	7.3887E+01	1.6784E+01
α_2	3.62E-02	7.57E-02	7.26E-02	1.26E-01	1.32E-01	6.8674E+00	8.3803E+01
α_3	2.81E-02	6.41E-02	6.09E-02	1.11E-01	1.27E-01	5.8103E+00	8.4860E+01
α_4	1.61E-02	4.53E-02	4.20E-02	8.58E-02	9.10E-02	4.1060E+00	8.6565E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8197410	0.8678780	0.8695230	0.9103950	0.6724880	1.2932E+02	1.9687E+01
α_2	1.90E-02	4.21E-02	4.00E-02	7.21E-02	8.43E-02	6.2690E+00	1.4274E+02
α_3	2.13E-02	4.54E-02	4.34E-02	7.64E-02	1.17E-01	6.7631E+00	1.4224E+02
α_4	1.22E-02	3.16E-02	2.95E-02	5.81E-02	8.79E-02	4.7077E+00	1.4430E+02
α_5	2.26E-03	1.31E-02	1.10E-02	3.11E-02	3.80E-02	1.9473E+00	1.4706E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8391590	0.8813440	0.8827820	0.9186200	0.7003500	1.5604E+02	2.1008E+01
α_2	1.00E-02	2.63E-02	2.45E-02	4.86E-02	4.33E-02	4.6539E+00	1.7239E+02
α_3	1.75E-02	3.77E-02	3.60E-02	6.38E-02	9.90E-02	6.6716E+00	1.7038E+02
α_4	1.37E-02	3.21E-02	3.03E-02	5.64E-02	9.11E-02	5.6755E+00	1.7137E+02
α_5	4.62E-03	1.69E-02	1.51E-02	3.52E-02	4.95E-02	2.9861E+00	1.7406E+02
α_6	3.13E-04	5.77E-03	4.04E-03	1.71E-02	1.68E-02	1.0207E+00	1.7603E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.6584530	0.6506720	0.6502190	0.6724880	0.7003500
α_2	3.42E-01	1.50E-01	1.32E-01	8.43E-02	4.33E-02
α_3		1.99E-01	1.27E-01	1.17E-01	9.90E-02
α_4			9.10E-02	8.79E-02	9.11E-02
α_5				3.80E-02	4.95E-02
α_6					1.68E-02

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	6.58E-01	6.51E-01	6.50E-01	6.72E-01	7.00E-01
Beta	3.42E-01	3.49E-01	3.50E-01	3.28E-01	3.00E-01
Gamma		5.70E-01	6.22E-01	7.43E-01	8.56E-01
Delta			4.18E-01	5.18E-01	6.14E-01
Epsilon				3.02E-01	4.21E-01
Mu					2.53E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	12.95	19.42	25.90	32.37	38.85
N_1	6.1381	3.8330	1.8512	0.7887	0.2500
N_2	9.9012	5.3741	5.6393	4.1548	2.4147
N_3		7.1098	5.4060	5.7857	5.5298
N_4			3.8833	4.3333	5.0833
N_5				1.8750	2.7639
N_6					0.9375

1.7 Heat Exchangers

1.7.1 PWR HEAT EXCHANGER LOSS OF HEAT TRANSFER

1.7.1.1 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 :	2009/12/31

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

1.7.2 Pooled Heat Exchanger Plugged or Failure to Transfer Heat

1.7.2.1 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/Wear
Accidental human action
Human action procedure
Other
Internal environment
Internal to component, piece-part
Unknown
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 17.60
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8960240	0.9738850	0.9891220	0.9999450	0.9993930	1.6342E+01	4.3822E-01
α_2	5.07E-05	2.61E-02	1.09E-02	1.04E-01	6.07E-04	4.3822E-01	1.6342E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9205160	0.9720670	0.9795230	0.9981150	0.9988290	3.8683E+01	1.1116E+00
α_2	7.01E-04	2.12E-02	1.39E-02	6.68E-02	1.16E-03	8.4426E-01	3.8950E+01
α_3	2.37E-07	6.72E-03	1.36E-03	3.19E-02	1.09E-05	2.6732E-01	3.9527E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9255750	0.9688180	0.9738650	0.9947920	0.9982750	5.8290E+01	1.8761E+00
α_2	1.78E-03	2.08E-02	1.57E-02	5.69E-02	1.68E-03	1.2486E+00	5.8917E+01
α_3	7.64E-06	6.73E-03	2.50E-03	2.78E-02	4.11E-05	4.0481E-01	5.9761E+01
α_4	1.60E-08	3.70E-03	5.07E-04	1.85E-02	0.00E+00	2.2267E-01	5.9943E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9993930	0.9988290	0.9982750
α_2	6.07E-04	1.16E-03	1.68E-03
α_3		1.09E-05	4.11E-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	6.07E-04	1.17E-03	1.72E-03
Gamma		9.35E-03	2.38E-02
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	5.87	8.80	11.73
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

1.7.3 Containment Spray Heat Exchanger

1.7.3.1 CONTAINMENT SPRAY HTX LOSS OF HEAT TRANSFER

System : Containment spray recirculation
Component : Heat Exchanger
Failure Mode : Loss of heat transfer capabilities in heat exchangers
No flow/plugged
Start Date : 1997/01/01
Data Version : 2009/12/31

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

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	2.50
N_1	0.0000
N_2	0.0000

1.7.4 BWR Residual Heat Removal Heat Exchanger

1.7.4.1 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 : 2009/12/31

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

1.7.5 BWR Isolation Condenser Heat Exchanger

1.7.5.1 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 :	2009/12/31

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

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	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

1.7.6 Component Cooling Heat Exchanger

1.7.6.1 CCW HEAT EXCHANGER LOSS OF HEAT TRANSFER SPAR: CCW-HTX-PG

System :	Component cooling water
Component :	Heat Exchanger
Failure Mode :	Fail to Operate (Open/Close) Loss of heat transfer capabilities in heat exchangers
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 18.60
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8886600	0.9684720	0.9827420	0.9996820	0.9799720	1.8579E+01	6.0482E-01
α_2	3.20E-04	3.15E-02	1.73E-02	1.11E-01	2.00E-02	6.0482E-01	1.8579E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9066870	0.9626550	0.9695650	0.9949460	0.9591410	4.1543E+01	1.6116E+00
α_2	3.10E-03	3.12E-02	2.42E-02	8.29E-02	4.09E-02	1.3443E+00	4.1810E+01
α_3	2.18E-07	6.19E-03	1.25E-03	2.94E-02	8.00E-06	2.6732E-01	4.2887E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9066780	0.9552820	0.9599340	0.9879690	0.9374590	6.1440E+01	2.8761E+00
α_2	7.30E-03	3.50E-02	3.02E-02	7.88E-02	6.25E-02	2.2486E+00	6.2067E+01
α_3	7.15E-06	6.29E-03	2.34E-03	2.60E-02	3.06E-05	4.0481E-01	6.3911E+01
α_4	1.49E-08	3.46E-03	4.74E-04	1.73E-02	0.00E+00	2.2267E-01	6.4093E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9799720	0.9591410	0.9374590
α_2	2.00E-02	4.09E-02	6.25E-02
α_3		8.00E-06	3.06E-05
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.80E-01	9.59E-01	9.37E-01
Beta	2.00E-02	4.09E-02	6.25E-02
Gamma		1.96E-04	4.90E-04
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	7.44	11.16	14.88
N_1	0.8927	0.8284	0.4242
N_2	0.1703	0.5106	1.0205
N_3		0.0001	0.0005
N_4			0.0000

1.8 Safety and Relief Valves

1.8.1 Pooled Safety Valves

1.8.1.1 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 :	2009/12/31

Total Number of Independent Failure Events: 4.00
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8474860	0.9613070	0.9834100	0.9999200	0.9890430	1.1004E+01	4.4292E-01
α_2	8.19E-05	3.87E-02	1.66E-02	1.53E-01	1.10E-02	4.4292E-01	1.1004E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9000550	0.9645780	0.9738030	0.9975160	0.9777540	3.0667E+01	1.1262E+00
α_2	9.46E-04	2.70E-02	1.79E-02	8.42E-02	2.22E-02	8.5896E-01	3.0934E+01
α_3	2.96E-07	8.40E-03	1.71E-03	3.99E-02	0.00E+00	2.6722E-01	3.1526E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9088610	0.9614960	0.9675470	0.9934010	0.9663220	4.7585E+01	1.9056E+00
α_2	2.33E-03	2.58E-02	1.98E-02	7.01E-02	3.37E-02	1.2786E+00	4.8212E+01
α_3	9.23E-06	8.17E-03	3.04E-03	3.37E-02	0.00E+00	4.0431E-01	4.9086E+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	0.9299010	0.9643290	0.9673370	0.9884610	0.9545700	9.7930E+01	3.6224E+00
α_2	4.37E-03	2.16E-02	1.86E-02	4.94E-02	4.54E-02	2.1984E+00	9.9354E+01
α_3	4.70E-04	9.62E-03	6.65E-03	2.89E-02	0.00E+00	9.7738E-01	1.0058E+02
α_4	2.43E-06	3.69E-03	1.24E-03	1.57E-02	0.00E+00	3.7439E-01	1.0118E+02
α_5	5.88E-21	7.12E-04	4.03E-07	4.12E-03	0.00E+00	7.2277E-02	1.0148E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9333380	0.9643080	0.9667930	0.9867860	0.9425600	1.1901E+02	4.4050E+00
α_2	4.19E-03	1.92E-02	1.66E-02	4.28E-02	5.74E-02	2.3655E+00	1.2105E+02
α_3	6.52E-04	9.25E-03	6.77E-03	2.63E-02	0.00E+00	1.1418E+00	1.2227E+02
α_4	4.29E-05	4.80E-03	2.51E-03	1.73E-02	0.00E+00	5.9222E-01	1.2282E+02
α_5	7.53E-09	1.80E-03	2.44E-04	9.02E-03	0.00E+00	2.2220E-01	1.2319E+02
α_6	1.14E-18	6.74E-04	1.18E-06	3.94E-03	0.00E+00	8.3237E-02	1.2333E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9418130	0.9656960	0.9672920	0.9841250	0.9302780	1.8641E+02	6.6218E+00
α_2	5.00E-03	1.69E-02	1.53E-02	3.44E-02	6.97E-02	3.2646E+00	1.8977E+02
α_3	1.14E-03	8.45E-03	6.82E-03	2.13E-02	0.00E+00	1.6312E+00	1.9140E+02
α_4	2.57E-04	5.12E-03	3.55E-03	1.54E-02	0.00E+00	9.8887E-01	1.9204E+02
α_5	1.33E-05	2.70E-03	1.28E-03	1.02E-02	0.00E+00	5.2177E-01	1.9251E+02
α_6	3.48E-10	9.65E-04	8.24E-05	5.07E-03	0.00E+00	1.8628E-01	1.9285E+02
α_7	0.00E+00	1.51E-04	1.32E-13	5.67E-04	0.00E+00	2.9071E-02	1.9300E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9448170	0.9663980	0.9677450	0.9833740	0.9177140	2.2136E+02	7.6967E+00
α_2	4.96E-03	1.56E-02	1.42E-02	3.10E-02	8.23E-02	3.5804E+00	2.2548E+02
α_3	1.12E-03	7.59E-03	6.21E-03	1.88E-02	0.00E+00	1.7384E+00	2.2732E+02
α_4	3.54E-04	5.01E-03	3.66E-03	1.43E-02	0.00E+00	1.1465E+00	2.2791E+02
α_5	5.63E-05	3.09E-03	1.82E-03	1.05E-02	0.00E+00	7.0833E-01	2.2835E+02
α_6	9.07E-07	1.60E-03	5.25E-04	6.85E-03	0.00E+00	3.6696E-01	2.2869E+02
α_7	7.11E-14	5.37E-04	9.66E-06	3.06E-03	0.00E+00	1.2297E-01	2.2893E+02
α_8	1.33E-42	1.45E-04	2.06E-12	6.11E-04	0.00E+00	3.3124E-02	2.2902E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9890430	0.9777540	0.9663220	0.9545700	0.9425600	0.9302780	0.9177140
α_2	1.10E-02	2.22E-02	3.37E-02	4.54E-02	5.74E-02	6.97E-02	8.23E-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	9.89E-01	9.78E-01	9.66E-01	9.55E-01	9.43E-01	9.30E-01	9.18E-01
Beta	1.10E-02	2.22E-02	3.37E-02	4.54E-02	5.74E-02	6.97E-02	8.23E-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	0.50	0.75	1.00	1.25	1.50	1.75	2.00
N_1	0.2582	0.3620	0.4490	0.5192	0.5725	0.6090	0.6287
N_2	0.0084	0.0253	0.0505	0.0842	0.1263	0.1768	0.2357
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

1.8.1.2 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 : 2009/12/31

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

1.8.2 PWR Steam Generator Safety Valves

1.8.2.1 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 : 2009/12/31

Total Number of Independent Failure Events: 2.00
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8441500	0.9604430	0.9830180	0.9999180	0.9837400	1.0754E+01	4.4292E-01
α_2	8.39E-05	3.96E-02	1.70E-02	1.56E-01	1.63E-02	4.4292E-01	1.0754E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8989010	0.9641610	0.9734880	0.9974860	0.9670270	3.0297E+01	1.1262E+00
α_2	9.57E-04	2.73E-02	1.81E-02	8.52E-02	3.30E-02	8.5896E-01	3.0564E+01
α_3	3.00E-07	8.50E-03	1.73E-03	4.03E-02	0.00E+00	2.6722E-01	3.1156E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9079480	0.9611030	0.9672170	0.9933320	0.9494750	4.7085E+01	1.9056E+00
α_2	2.35E-03	2.61E-02	2.00E-02	7.08E-02	5.05E-02	1.2786E+00	4.7712E+01
α_3	9.32E-06	8.25E-03	3.07E-03	3.41E-02	0.00E+00	4.0431E-01	4.8586E+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	0.9837400	0.9670270	0.9494750
α_2	1.63E-02	3.30E-02	5.05E-02
α_3		0.00E+00	0.00E+00
α_4			0.00E+00

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.84E-01	9.67E-01	9.49E-01
Beta	1.63E-02	3.30E-02	5.05E-02
Gamma		0.00E+00	0.00E+00
Delta			0.00E+00

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	0.25	0.38	0.50
N_1	0.2582	0.3620	0.4490
N_2	0.0084	0.0253	0.0505
N_3		0.0000	0.0000
N_4			0.0000

1.8.2.2 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 :	2009/12/31

Total Number of Independent Failure Events: 5.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8488640	0.9616670	0.9835770	0.9999210	0.9904770	1.1109E+01	4.4282E-01
α_2	8.10E-05	3.83E-02	1.64E-02	1.51E-01	9.52E-03	4.4282E-01	1.1109E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9005410	0.9647570	0.9739410	0.9975300	0.9806200	3.0820E+01	1.1259E+00
α_2	9.40E-04	2.69E-02	1.78E-02	8.38E-02	1.94E-02	8.5866E-01	3.1087E+01
α_3	2.95E-07	8.36E-03	1.70E-03	3.97E-02	0.00E+00	2.6722E-01	3.1679E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9092380	0.9616620	0.9676890	0.9934320	0.9705880	4.7786E+01	1.9051E+00
α_2	2.32E-03	2.57E-02	1.97E-02	6.98E-02	2.94E-02	1.2781E+00	4.8413E+01
α_3	9.19E-06	8.14E-03	3.03E-03	3.36E-02	0.00E+00	4.0431E-01	4.9287E+01
α_4	1.94E-08	4.48E-03	6.15E-04	2.25E-02	0.00E+00	2.2267E-01	4.9468E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9300820	0.9644250	0.9674260	0.9884950	0.9603640	9.8179E+01	3.6215E+00
α_2	4.36E-03	2.16E-02	1.85E-02	4.93E-02	3.96E-02	2.1975E+00	9.9603E+01
α_3	4.69E-04	9.60E-03	6.64E-03	2.89E-02	0.00E+00	9.7738E-01	1.0082E+02
α_4	2.42E-06	3.68E-03	1.24E-03	1.56E-02	0.00E+00	3.7439E-01	1.0143E+02
α_5	5.86E-21	7.10E-04	4.02E-07	4.11E-03	0.00E+00	7.2277E-02	1.0173E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9335170	0.9644070	0.9668820	0.9868260	0.9501000	1.1932E+02	4.4037E+00
α_2	4.18E-03	1.91E-02	1.66E-02	4.27E-02	4.99E-02	2.3642E+00	1.2136E+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	0.9419290	0.9657670	0.9673600	0.9841610	0.9394460	1.8676E+02	6.6200E+00
α_2	4.98E-03	1.69E-02	1.52E-02	3.44E-02	6.06E-02	3.2628E+00	1.9012E+02
α_3	1.14E-03	8.44E-03	6.81E-03	2.13E-02	0.00E+00	1.6312E+00	1.9175E+02
α_4	2.56E-04	5.11E-03	3.54E-03	1.53E-02	0.00E+00	9.8887E-01	1.9239E+02
α_5	1.33E-05	2.70E-03	1.28E-03	1.02E-02	0.00E+00	5.2177E-01	1.9286E+02
α_6	3.48E-10	9.63E-04	8.23E-05	5.06E-03	0.00E+00	1.8628E-01	1.9319E+02
α_7	0.00E+00	1.50E-04	1.32E-13	5.66E-04	0.00E+00	2.9071E-02	1.9335E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9449250	0.9664670	0.9678120	0.9834110	0.9285800	2.2176E+02	7.6943E+00
α_2	4.95E-03	1.56E-02	1.42E-02	3.10E-02	7.14E-02	3.5780E+00	2.2588E+02
α_3	1.12E-03	7.58E-03	6.20E-03	1.87E-02	0.00E+00	1.7384E+00	2.2772E+02
α_4	3.54E-04	5.00E-03	3.65E-03	1.42E-02	0.00E+00	1.1465E+00	2.2831E+02
α_5	5.62E-05	3.09E-03	1.81E-03	1.04E-02	0.00E+00	7.0833E-01	2.2875E+02
α_6	9.05E-07	1.60E-03	5.24E-04	6.84E-03	0.00E+00	3.6696E-01	2.2909E+02
α_7	7.10E-14	5.36E-04	9.64E-06	3.05E-03	0.00E+00	1.2297E-01	2.2933E+02
α_8	1.33E-42	1.44E-04	2.06E-12	6.10E-04	0.00E+00	3.3124E-02	2.2942E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9904770	0.9806200	0.9705880	0.9603640	0.9501000	0.9394460	0.9285800
α_2	9.52E-03	1.94E-02	2.94E-02	3.96E-02	4.99E-02	6.06E-02	7.14E-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	9.90E-01	9.81E-01	9.71E-01	9.60E-01	9.50E-01	9.39E-01	9.29E-01
Beta	9.52E-03	1.94E-02	2.94E-02	3.96E-02	4.99E-02	6.06E-02	7.14E-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	0.63	0.94	1.25	1.56	1.88	2.19	2.50
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

1.8.3 BWR Safety Relief Valves

1.8.3.1 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 : 2009/12/31

Total Number of Independent Failure Events: 18.50
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8782190	0.9684030	0.9856570	0.9999020	0.9905680	1.4583E+01	4.7582E-01
α_2	9.98E-05	3.16E-02	1.43E-02	1.22E-01	9.43E-03	4.7582E-01	1.4583E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9099610	0.9672820	0.9752540	0.9973160	0.9823210	3.5950E+01	1.2160E+00
α_2	1.15E-03	2.54E-02	1.75E-02	7.67E-02	1.70E-02	9.4436E-01	3.6222E+01
α_3	3.04E-07	7.31E-03	1.52E-03	3.45E-02	6.76E-04	2.7162E-01	3.6894E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9156100	0.9634550	0.9687840	0.9930620	0.9752130	5.4532E+01	2.0685E+00
α_2	2.76E-03	2.52E-02	1.98E-02	6.59E-02	2.28E-02	1.4247E+00	5.5176E+01
α_3	1.09E-05	7.43E-03	2.89E-03	3.03E-02	1.92E-03	4.2081E-01	5.6180E+01
α_4	1.73E-08	3.94E-03	5.42E-04	1.97E-02	3.48E-05	2.2297E-01	5.6378E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9323120	0.9649610	0.9677340	0.9881180	0.9691750	1.0651E+02	3.8675E+00
α_2	4.85E-03	2.18E-02	1.90E-02	4.83E-02	2.71E-02	2.4036E+00	1.0797E+02
α_3	4.95E-04	9.20E-03	6.46E-03	2.73E-02	3.59E-03	1.0157E+00	1.0936E+02
α_4	2.30E-06	3.41E-03	1.15E-03	1.44E-02	1.40E-04	3.7589E-01	1.1000E+02
α_5	5.41E-21	6.55E-04	3.70E-07	3.79E-03	0.00E+00	7.2277E-02	1.1031E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9351520	0.9646510	0.9669390	0.9863150	0.9641470	1.2921E+02	4.7349E+00
α_2	4.75E-03	1.96E-02	1.72E-02	4.24E-02	3.00E-02	2.6204E+00	1.3132E+02
α_3	7.23E-04	9.05E-03	6.75E-03	2.52E-02	5.54E-03	1.2123E+00	1.3273E+02
α_4	4.12E-05	4.45E-03	2.35E-03	1.60E-02	3.54E-04	5.9672E-01	1.3335E+02
α_5	6.93E-09	1.66E-03	2.25E-04	8.31E-03	0.00E+00	2.2220E-01	1.3372E+02
α_6	1.05E-18	6.21E-04	1.09E-06	3.63E-03	0.00E+00	8.3237E-02	1.3386E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9426260	0.9657270	0.9672330	0.9836920	0.9600310	1.9821E+02	7.0344E+00
α_2	5.47E-03	1.73E-02	1.58E-02	3.44E-02	3.16E-02	3.5538E+00	2.0169E+02
α_3	1.26E-03	8.50E-03	6.96E-03	2.10E-02	7.65E-03	1.7440E+00	2.0350E+02
α_4	2.51E-04	4.87E-03	3.39E-03	1.46E-02	7.19E-04	9.9947E-01	2.0424E+02
α_5	1.25E-05	2.54E-03	1.20E-03	9.61E-03	0.00E+00	5.2177E-01	2.0472E+02
α_6	3.27E-10	9.08E-04	7.75E-05	4.76E-03	0.00E+00	1.8628E-01	2.0506E+02
α_7	0.00E+00	1.42E-04	1.24E-13	5.33E-04	0.00E+00	2.9071E-02	2.0522E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9453760	0.9663080	0.9675790	0.9828980	0.9567580	2.3476E+02	8.1853E+00
α_2	5.39E-03	1.60E-02	1.47E-02	3.11E-02	3.22E-02	3.8842E+00	2.3906E+02
α_3	1.31E-03	7.83E-03	6.53E-03	1.88E-02	9.77E-03	1.9020E+00	2.4104E+02
α_4	3.54E-04	4.81E-03	3.53E-03	1.36E-02	1.27E-03	1.1677E+00	2.4178E+02
α_5	5.31E-05	2.92E-03	1.71E-03	9.87E-03	0.00E+00	7.0833E-01	2.4224E+02
α_6	8.55E-07	1.51E-03	4.94E-04	6.46E-03	0.00E+00	3.6696E-01	2.4258E+02
α_7	6.70E-14	5.06E-04	9.10E-06	2.88E-03	0.00E+00	1.2297E-01	2.4282E+02
α_8	1.26E-42	1.36E-04	1.94E-12	5.76E-04	0.00E+00	3.3124E-02	2.4291E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9905680	0.9823210	0.9752130	0.9691750	0.9641470	0.9600310	0.9567580
α_2	9.43E-03	1.70E-02	2.28E-02	2.71E-02	3.00E-02	3.16E-02	3.22E-02
α_3		6.76E-04	1.92E-03	3.59E-03	5.54E-03	7.65E-03	9.77E-03
α_4			3.48E-05	1.40E-04	3.54E-04	7.19E-04	1.27E-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	9.91E-01	9.82E-01	9.75E-01	9.69E-01	9.64E-01	9.60E-01	9.57E-01
Beta	9.43E-03	1.77E-02	2.48E-02	3.08E-02	3.59E-02	4.00E-02	4.32E-02
Gamma		3.82E-02	7.87E-02	1.21E-01	1.64E-01	2.09E-01	2.55E-01
Delta			1.79E-02	3.77E-02	6.00E-02	8.59E-02	1.15E-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	3.70	5.55	7.40	9.25	11.10	12.95	14.80
N_1	0.6373	0.8453	0.9960	1.1003	1.1679	1.2072	1.2255
N_2	0.0413	0.1107	0.1966	0.2894	0.3812	0.4660	0.5395
N_3		0.0044	0.0165	0.0383	0.0705	0.1128	0.1636
N_4			0.0003	0.0015	0.0045	0.0106	0.0212
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

1.8.3.2 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 : 2009/12/31

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

1.8.4 PWR Pressurizer Safety Valve

1.8.4.1 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 :	2009/12/31

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

1.8.4.2 PWR PRESSURIZER CODE SAFETIES FAIL TO CLOSE

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 : 2009/12/31

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 PORVs

1.9.1 Pooled PORVs

1.9.1.1 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 :	2009/12/31

Total Number of Independent Failure Events: 91.20
Total Number of Common-Cause Failure Events: 8

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9271650	0.9730840	0.9793580	0.9975380	0.9770370	4.6583E+01	1.2885E+00
α_2	2.46E-03	2.69E-02	2.06E-02	7.28E-02	2.30E-02	1.2885E+00	4.6583E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9261210	0.9640610	0.9676230	0.9898060	0.9640450	8.2395E+01	3.0716E+00
α_2	6.87E-03	2.94E-02	2.58E-02	6.41E-02	3.06E-02	2.5087E+00	8.2958E+01
α_3	4.70E-05	6.59E-03	3.33E-03	2.42E-02	5.39E-03	5.6292E-01	8.4904E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9346400	0.9655630	0.9681170	0.9877590	0.9683630	1.1616E+02	4.1429E+00
α_2	4.29E-03	1.96E-02	1.70E-02	4.39E-02	1.57E-02	2.3624E+00	1.1794E+02
α_3	1.18E-03	1.15E-02	8.91E-03	3.06E-02	1.35E-02	1.3814E+00	1.1892E+02
α_4	3.41E-06	3.32E-03	1.21E-03	1.38E-02	2.44E-03	3.9907E-01	1.1990E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9446240	0.9680260	0.9696590	0.9858390	0.9719320	1.8340E+02	6.0577E+00
α_2	4.27E-03	1.57E-02	1.40E-02	3.28E-02	9.55E-03	2.9713E+00	1.8649E+02
α_3	1.68E-03	1.00E-02	8.36E-03	2.41E-02	1.03E-02	1.8993E+00	1.8756E+02
α_4	2.88E-04	5.37E-03	3.76E-03	1.59E-02	7.16E-03	1.0169E+00	1.8844E+02
α_5	7.66E-11	8.98E-04	5.82E-05	4.82E-03	1.09E-03	1.7018E-01	1.8929E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9484620	0.9692530	0.9706120	0.9853950	0.9743990	2.2136E+02	7.0221E+00
α_2	3.75E-03	1.34E-02	1.20E-02	2.78E-02	7.68E-03	3.0623E+00	2.2532E+02
α_3	1.19E-03	7.77E-03	6.39E-03	1.91E-02	5.91E-03	1.7754E+00	2.2661E+02
α_4	6.56E-04	6.18E-03	4.81E-03	1.64E-02	7.64E-03	1.4112E+00	2.2697E+02
α_5	3.49E-05	2.81E-03	1.55E-03	9.85E-03	3.91E-03	6.4100E-01	2.2774E+02
α_6	3.96E-13	5.79E-04	1.45E-05	3.26E-03	4.57E-04	1.3224E-01	2.2825E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9527840	0.9700630	0.9710570	0.9839610	0.9760240	3.0559E+02	9.4307E+00
α_2	4.40E-03	1.28E-02	1.18E-02	2.46E-02	7.50E-03	4.0222E+00	3.1100E+02
α_3	1.18E-03	6.46E-03	5.45E-03	1.52E-02	3.24E-03	2.0350E+00	3.1299E+02
α_4	7.34E-04	5.29E-03	4.29E-03	1.33E-02	5.44E-03	1.6660E+00	3.1335E+02
α_5	3.06E-04	3.85E-03	2.86E-03	1.08E-02	5.55E-03	1.2128E+00	3.1381E+02
α_6	2.87E-06	1.41E-03	5.75E-04	5.65E-03	2.07E-03	4.4458E-01	3.1458E+02
α_7	1.93E-29	1.59E-04	1.81E-09	8.47E-04	1.69E-04	5.0071E-02	3.1497E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9552050	0.9709020	0.9717540	0.9837030	0.9770990	3.5733E+02	1.0709E+01
α_2	4.46E-03	1.21E-02	1.12E-02	2.27E-02	7.80E-03	4.4505E+00	3.6359E+02
α_3	1.03E-03	5.57E-03	4.71E-03	1.31E-02	2.21E-03	2.0512E+00	3.6599E+02
α_4	5.43E-04	4.27E-03	3.42E-03	1.09E-02	3.01E-03	1.5731E+00	3.6647E+02
α_5	4.08E-04	3.84E-03	2.99E-03	1.02E-02	4.97E-03	1.4135E+00	3.6663E+02
α_6	1.01E-04	2.49E-03	1.66E-03	7.68E-03	3.86E-03	9.1486E-01	3.6712E+02
α_7	2.39E-08	7.23E-04	1.43E-04	3.43E-03	1.01E-03	2.6607E-01	3.6777E+02
α_8	5.93E-36	1.09E-04	4.96E-11	5.25E-04	4.93E-05	4.0124E-02	3.6800E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9770370	0.9640450	0.9683630	0.9719320	0.9743990	0.9760240	0.9770990
α_2	2.30E-02	3.06E-02	1.57E-02	9.55E-03	7.68E-03	7.50E-03	7.80E-03
α_3		5.39E-03	1.35E-02	1.03E-02	5.91E-03	3.24E-03	2.21E-03
α_4			2.44E-03	7.16E-03	7.64E-03	5.44E-03	3.01E-03
α_5				1.09E-03	3.91E-03	5.55E-03	4.97E-03
α_6					4.57E-04	2.07E-03	3.86E-03
α_7						1.69E-04	1.01E-03
α_8							4.93E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.77E-01	9.64E-01	9.68E-01	9.72E-01	9.74E-01	9.76E-01	9.77E-01
Beta	2.30E-02	3.60E-02	3.16E-02	2.81E-02	2.56E-02	2.40E-02	2.29E-02
Gamma		1.50E-01	5.04E-01	6.60E-01	7.00E-01	6.87E-01	6.60E-01
Delta			1.53E-01	4.45E-01	6.70E-01	8.03E-01	8.54E-01
Epsilon				1.32E-01	3.64E-01	5.89E-01	7.67E-01
Mu					1.05E-01	2.88E-01	4.97E-01
Upsilon						7.52E-02	2.15E-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	33.16	49.75	66.33	82.91	99.49	116.07	132.65
N_1	3.1765	3.0898	3.6969	4.3316	4.9292	5.4682	5.9489
N_2	0.8540	1.6750	1.1343	0.8571	0.8231	0.9344	1.1058
N_3		0.2957	0.9771	0.9219	0.6336	0.4038	0.3128
N_4			0.1764	0.6425	0.8190	0.6771	0.4266
N_5				0.0979	0.4188	0.6910	0.7052
N_6					0.0490	0.2583	0.5479
N_7						0.0210	0.1431
N_8							0.0070

1.9.1.2 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 : 2009/12/31

Total Number of Independent Failure Events: 27.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9280910	0.9820330	0.9926450	0.9999640	0.9998750	2.3843E+01	4.3622E-01
α_2	3.35E-05	1.80E-02	7.36E-03	7.19E-02	1.25E-04	4.3622E-01	2.3843E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9380420	0.9783380	0.9842070	0.9985600	0.9997550	4.9945E+01	1.1059E+00
α_2	5.30E-04	1.64E-02	1.07E-02	5.20E-02	2.45E-04	8.3866E-01	5.0212E+01
α_3	1.83E-07	5.23E-03	1.05E-03	2.48E-02	0.00E+00	2.6722E-01	5.0784E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9405030	0.9751920	0.9792780	0.9959030	0.9996320	7.3316E+01	1.8651E+00
α_2	1.38E-03	1.65E-02	1.24E-02	4.54E-02	3.68E-04	1.2381E+00	7.3943E+01
α_3	6.05E-06	5.38E-03	1.99E-03	2.22E-02	0.00E+00	4.0431E-01	7.4777E+01
α_4	1.28E-08	2.96E-03	4.05E-04	1.48E-02	0.00E+00	2.2267E-01	7.4958E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9473080	0.9734130	0.9757430	0.9915640	0.9995290	1.3013E+02	3.5542E+00
α_2	3.09E-03	1.59E-02	1.36E-02	3.68E-02	4.62E-04	2.1299E+00	1.3155E+02
α_3	3.57E-04	7.31E-03	5.05E-03	2.20E-02	8.83E-06	9.7768E-01	1.3271E+02
α_4	1.84E-06	2.80E-03	9.42E-04	1.19E-02	0.00E+00	3.7439E-01	1.3331E+02
α_5	4.46E-21	5.41E-04	3.05E-07	3.13E-03	0.00E+00	7.2277E-02	1.3361E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9499490	0.9734440	0.9753720	0.9903570	0.9994310	1.5769E+02	4.3019E+00
α_2	2.90E-03	1.40E-02	1.20E-02	3.17E-02	5.49E-04	2.2616E+00	1.5973E+02
α_3	4.97E-04	7.05E-03	5.16E-03	2.01E-02	1.96E-05	1.1426E+00	1.6085E+02
α_4	3.27E-05	3.66E-03	1.91E-03	1.32E-02	0.00E+00	5.9222E-01	1.6140E+02
α_5	5.73E-09	1.37E-03	1.86E-04	6.87E-03	0.00E+00	2.2220E-01	1.6177E+02
α_6	8.70E-19	5.14E-04	8.98E-07	3.00E-03	0.00E+00	8.3237E-02	1.6191E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9535230	0.9727940	0.9741100	0.9875750	0.9993340	2.3158E+02	6.4767E+00
α_2	3.72E-03	1.31E-02	1.18E-02	2.71E-02	6.33E-04	3.1179E+00	2.3494E+02
α_3	9.25E-04	6.86E-03	5.54E-03	1.73E-02	3.36E-05	1.6328E+00	2.3642E+02
α_4	2.08E-04	4.15E-03	2.87E-03	1.25E-02	0.00E+00	9.8887E-01	2.3707E+02
α_5	1.08E-05	2.19E-03	1.04E-03	8.28E-03	0.00E+00	5.2177E-01	2.3753E+02
α_6	2.82E-10	7.83E-04	6.68E-05	4.11E-03	0.00E+00	1.8628E-01	2.3787E+02
α_7	0.00E+00	1.22E-04	1.07E-13	4.60E-04	0.00E+00	2.9071E-02	2.3803E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9557630	0.9732590	0.9743780	0.9869420	0.9992440	2.7304E+02	7.5021E+00
α_2	3.66E-03	1.21E-02	1.09E-02	2.44E-02	7.08E-04	3.3832E+00	2.7716E+02
α_3	9.19E-04	6.21E-03	5.08E-03	1.53E-02	4.60E-05	1.7409E+00	2.7880E+02
α_4	2.89E-04	4.09E-03	2.99E-03	1.16E-02	1.84E-06	1.1466E+00	2.7940E+02
α_5	4.59E-05	2.52E-03	1.48E-03	8.55E-03	0.00E+00	7.0833E-01	2.7983E+02
α_6	7.40E-07	1.31E-03	4.28E-04	5.60E-03	0.00E+00	3.6696E-01	2.8018E+02
α_7	5.80E-14	4.38E-04	7.88E-06	2.50E-03	0.00E+00	1.2297E-01	2.8042E+02
α_8	1.09E-42	1.18E-04	1.68E-12	4.99E-04	0.00E+00	3.3124E-02	2.8051E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9998750	0.9997550	0.9996320	0.9995290	0.9994310	0.9993340	0.9992440
α_2	1.25E-04	2.45E-04	3.68E-04	4.62E-04	5.49E-04	6.33E-04	7.08E-04
α_3		0.00E+00	0.00E+00	8.83E-06	1.96E-05	3.36E-05	4.60E-05
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-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	1.25E-04	2.45E-04	3.68E-04	4.71E-04	5.69E-04	6.66E-04	7.56E-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	13.50	20.25	27.00	33.75	40.50	47.25	54.00
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

1.9.2 PWR Steam Generator PORV

1.9.2.1 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 : 2009/12/31

Total Number of Independent Failure Events: 73.10
Total Number of Common-Cause Failure Events: 6

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9051960	0.9650070	0.9731650	0.9968730	0.9673840	3.4982E+01	1.2685E+00
α_2	3.13E-03	3.50E-02	2.68E-02	9.48E-02	3.26E-02	1.2685E+00	3.4982E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9087430	0.9556880	0.9600920	0.9875720	0.9488030	6.5039E+01	3.0156E+00
α_2	8.29E-03	3.61E-02	3.16E-02	7.91E-02	4.33E-02	2.4547E+00	6.5600E+01
α_3	5.80E-05	8.24E-03	4.16E-03	3.03E-02	7.85E-03	5.6092E-01	6.7494E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9207720	0.9584230	0.9615350	0.9854270	0.9555690	9.3090E+01	4.0383E+00
α_2	4.88E-03	2.33E-02	2.01E-02	5.27E-02	2.11E-02	2.2652E+00	9.4863E+01
α_3	1.44E-03	1.41E-02	1.10E-02	3.77E-02	1.97E-02	1.3742E+00	9.5754E+01
α_4	4.21E-06	4.11E-03	1.49E-03	1.71E-02	3.59E-03	3.9887E-01	9.6729E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9361030	0.9632800	0.9651940	0.9839380	0.9612620	1.5464E+02	5.8948E+00
α_2	4.59E-03	1.76E-02	1.56E-02	3.73E-02	1.17E-02	2.8255E+00	1.5771E+02
α_3	1.94E-03	1.17E-02	9.77E-03	2.82E-02	1.49E-02	1.8831E+00	1.5865E+02
α_4	3.40E-04	6.33E-03	4.43E-03	1.88E-02	1.05E-02	1.0160E+00	1.5952E+02
α_5	9.05E-11	1.06E-03	6.87E-05	5.69E-03	1.61E-03	1.7018E-01	1.6036E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9408610	0.9649300	0.9665170	0.9835720	0.9653100	1.8692E+02	6.7935E+00
α_2	3.90E-03	1.48E-02	1.32E-02	3.13E-02	8.64E-03	2.8655E+00	1.9085E+02
α_3	1.34E-03	9.01E-03	7.39E-03	2.22E-02	8.34E-03	1.7462E+00	1.9197E+02
α_4	7.71E-04	7.27E-03	5.66E-03	1.93E-02	1.13E-02	1.4087E+00	1.9230E+02
α_5	4.12E-05	3.31E-03	1.83E-03	1.16E-02	5.78E-03	6.4090E-01	1.9307E+02
α_6	4.67E-13	6.83E-04	1.71E-05	3.85E-03	6.76E-04	1.3224E-01	1.9358E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9472650	0.9667500	0.9678740	0.9823820	0.9680710	2.6549E+02	9.1313E+00
α_2	4.53E-03	1.37E-02	1.26E-02	2.69E-02	8.16E-03	3.7742E+00	2.7085E+02
α_3	1.28E-03	7.24E-03	6.09E-03	1.72E-02	4.25E-03	1.9891E+00	2.7263E+02
α_4	8.36E-04	6.05E-03	4.90E-03	1.52E-02	7.99E-03	1.6609E+00	2.7296E+02
α_5	3.51E-04	4.41E-03	3.29E-03	1.23E-02	8.21E-03	1.2124E+00	2.7341E+02
α_6	3.29E-06	1.62E-03	6.60E-04	6.48E-03	3.07E-03	4.4458E-01	2.7418E+02
α_7	2.21E-29	1.82E-04	2.07E-09	9.72E-04	2.50E-04	5.0071E-02	2.7457E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9502770	0.9678940	0.9688610	0.9822210	0.9699730	3.1159E+02	1.0336E+01
α_2	4.55E-03	1.29E-02	1.19E-02	2.47E-02	8.44E-03	4.1529E+00	3.1777E+02
α_3	1.09E-03	6.17E-03	5.18E-03	1.46E-02	2.58E-03	1.9850E+00	3.1994E+02
α_4	6.12E-04	4.86E-03	3.88E-03	1.25E-02	4.36E-03	1.5640E+00	3.2036E+02
α_5	4.66E-04	4.39E-03	3.41E-03	1.16E-02	7.36E-03	1.4127E+00	3.2051E+02
α_6	1.16E-04	2.84E-03	1.90E-03	8.77E-03	5.72E-03	9.1486E-01	3.2101E+02
α_7	2.74E-08	8.26E-04	1.63E-04	3.93E-03	1.49E-03	2.6607E-01	3.2166E+02
α_8	6.78E-36	1.25E-04	5.67E-11	6.00E-04	7.31E-05	4.0124E-02	3.2189E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9673840	0.9488030	0.9555690	0.9612620	0.9653100	0.9680710	0.9699730
α_2	3.26E-02	4.33E-02	2.11E-02	1.17E-02	8.64E-03	8.16E-03	8.44E-03
α_3		7.85E-03	1.97E-02	1.49E-02	8.34E-03	4.25E-03	2.58E-03
α_4			3.59E-03	1.05E-02	1.13E-02	7.99E-03	4.36E-03
α_5				1.61E-03	5.78E-03	8.21E-03	7.36E-03
α_6					6.76E-04	3.07E-03	5.72E-03
α_7						2.50E-04	1.49E-03
α_8							7.31E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.67E-01	9.49E-01	9.56E-01	9.61E-01	9.65E-01	9.68E-01	9.70E-01
Beta	3.26E-02	5.12E-02	4.44E-02	3.87E-02	3.47E-02	3.19E-02	3.00E-02
Gamma		1.53E-01	5.25E-01	6.98E-01	7.51E-01	7.44E-01	7.19E-01
Delta			1.54E-01	4.49E-01	6.80E-01	8.21E-01	8.81E-01
Epsilon				1.32E-01	3.64E-01	5.91E-01	7.71E-01
Mu					1.05E-01	2.88E-01	4.98E-01
Upsilon						7.52E-02	2.15E-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	21.92	32.88	43.84	54.80	65.76	76.72	87.68
N_1	2.8165	2.6038	3.1137	3.6755	4.2206	4.7242	5.1836
N_2	0.8340	1.6210	1.0371	0.7113	0.6263	0.6864	0.8082
N_3		0.2937	0.9699	0.9057	0.6044	0.3579	0.2466
N_4			0.1762	0.6416	0.8165	0.6720	0.4175
N_5				0.0979	0.4187	0.6906	0.7044
N_6					0.0490	0.2583	0.5479
N_7						0.0210	0.1431
N_8							0.0070

1.9.2.2 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 :	2009/12/31

Total Number of Independent Failure Events: 22.00
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9199030	0.9799710	0.9917700	0.9999590	0.9998470	2.1343E+01	4.3622E-01
α_2	3.75E-05	2.00E-02	8.23E-03	8.01E-02	1.53E-04	4.3622E-01	2.1343E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9331950	0.9766200	0.9829380	0.9984430	0.9997000	4.6195E+01	1.1059E+00
α_2	5.72E-04	1.77E-02	1.15E-02	5.60E-02	3.00E-04	8.3866E-01	4.6462E+01
α_3	1.98E-07	5.65E-03	1.14E-03	2.68E-02	0.00E+00	2.6722E-01	4.7034E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9363210	0.9734250	0.9777880	0.9956060	0.9995490	6.8316E+01	1.8651E+00
α_2	1.48E-03	1.76E-02	1.33E-02	4.86E-02	4.51E-04	1.2381E+00	6.8943E+01
α_3	6.48E-06	5.76E-03	2.13E-03	2.38E-02	0.00E+00	4.0431E-01	6.9777E+01
α_4	1.37E-08	3.17E-03	4.34E-04	1.59E-02	0.00E+00	2.2267E-01	6.9958E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9447500	0.9721090	0.9745460	0.9911400	0.9994230	1.2388E+02	3.5542E+00
α_2	3.24E-03	1.67E-02	1.43E-02	3.86E-02	5.66E-04	2.1299E+00	1.2530E+02
α_3	3.75E-04	7.67E-03	5.30E-03	2.31E-02	1.08E-05	9.7768E-01	1.2646E+02
α_4	1.93E-06	2.94E-03	9.89E-04	1.25E-02	0.00E+00	3.7439E-01	1.2706E+02
α_5	4.68E-21	5.67E-04	3.21E-07	3.28E-03	0.00E+00	7.2277E-02	1.2736E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9475430	0.9721550	0.9741710	0.9898830	0.9993030	1.5019E+02	4.3019E+00
α_2	3.04E-03	1.46E-02	1.26E-02	3.32E-02	6.73E-04	2.2616E+00	1.5223E+02
α_3	5.21E-04	7.40E-03	5.41E-03	2.11E-02	2.40E-05	1.1426E+00	1.5335E+02
α_4	3.42E-05	3.83E-03	2.01E-03	1.38E-02	0.00E+00	5.9222E-01	1.5390E+02
α_5	6.01E-09	1.44E-03	1.95E-04	7.21E-03	0.00E+00	2.2220E-01	1.5427E+02
α_6	9.12E-19	5.39E-04	9.42E-07	3.14E-03	0.00E+00	8.3237E-02	1.5441E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9517690	0.9717550	0.9731190	0.9870960	0.9991830	2.2283E+02	6.4767E+00
α_2	3.86E-03	1.36E-02	1.22E-02	2.81E-02	7.75E-04	3.1179E+00	2.2619E+02
α_3	9.60E-04	7.12E-03	5.75E-03	1.80E-02	4.12E-05	1.6328E+00	2.2767E+02
α_4	2.16E-04	4.31E-03	2.98E-03	1.29E-02	0.00E+00	9.8887E-01	2.2832E+02
α_5	1.12E-05	2.28E-03	1.08E-03	8.60E-03	0.00E+00	5.2177E-01	2.2878E+02
α_6	2.93E-10	8.12E-04	6.93E-05	4.26E-03	0.00E+00	1.8628E-01	2.2912E+02
α_7	0.00E+00	1.27E-04	1.11E-13	4.77E-04	0.00E+00	2.9071E-02	2.2928E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9541360	0.9722700	0.9734240	0.9864510	0.9990730	2.6304E+02	7.5021E+00
α_2	3.79E-03	1.25E-02	1.13E-02	2.53E-02	8.68E-04	3.3832E+00	2.6716E+02
α_3	9.53E-04	6.43E-03	5.27E-03	1.59E-02	5.64E-05	1.7409E+00	2.6880E+02
α_4	3.00E-04	4.24E-03	3.10E-03	1.21E-02	2.25E-06	1.1466E+00	2.6940E+02
α_5	4.76E-05	2.62E-03	1.54E-03	8.86E-03	0.00E+00	7.0833E-01	2.6983E+02
α_6	7.67E-07	1.36E-03	4.44E-04	5.80E-03	0.00E+00	3.6696E-01	2.7018E+02
α_7	6.02E-14	4.55E-04	8.17E-06	2.59E-03	0.00E+00	1.2297E-01	2.7042E+02
α_8	1.13E-42	1.22E-04	1.74E-12	5.17E-04	0.00E+00	3.3124E-02	2.7051E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9998470	0.9997000	0.9995490	0.9994230	0.9993030	0.9991830	0.9990730
α_2	1.53E-04	3.00E-04	4.51E-04	5.66E-04	6.73E-04	7.75E-04	8.68E-04
α_3		0.00E+00	0.00E+00	1.08E-05	2.40E-05	4.12E-05	5.64E-05
α_4			0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.25E-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	9.99E-01	9.99E-01	9.99E-01	9.99E-01
Beta	1.53E-04	3.00E-04	4.51E-04	5.77E-04	6.97E-04	8.17E-04	9.27E-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	11.00	16.50	22.00	27.50	33.00	38.50	44.00
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

1.9.3 PWR Pressurizer Power Operated Relief Valves

1.9.3.1 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 :	2009/12/31

Total Number of Independent Failure Events: 16.10
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9339620	0.9832650	0.9928760	0.9999570	0.9987860	2.6706E+01	4.5452E-01
α_2	3.98E-05	1.67E-02	7.13E-03	6.60E-02	1.21E-03	4.5452E-01	2.6706E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9411230	0.9790980	0.9845380	0.9984670	0.9977320	5.4191E+01	1.1569E+00
α_2	6.09E-04	1.60E-02	1.07E-02	4.97E-02	2.19E-03	8.8766E-01	5.4460E+01
α_3	1.84E-07	4.86E-03	9.92E-04	2.30E-02	8.10E-05	2.6922E-01	5.5079E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9427760	0.9757700	0.9795800	0.9957340	0.9968190	7.8919E+01	1.9597E+00
α_2	1.57E-03	1.64E-02	1.26E-02	4.42E-02	2.96E-03	1.3253E+00	7.9553E+01
α_3	6.42E-06	5.09E-03	1.92E-03	2.09E-02	2.19E-04	4.1151E-01	8.0467E+01
α_4	1.20E-08	2.76E-03	3.77E-04	1.38E-02	6.08E-06	2.2287E-01	8.0656E+01

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9987860	0.9977320	0.9968190
α_2	1.21E-03	2.19E-03	2.96E-03
α_3		8.10E-05	2.19E-04
α_4			6.08E-06

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.99E-01	9.98E-01	9.97E-01
Beta	1.21E-03	2.27E-03	3.18E-03
Gamma		3.57E-02	7.07E-02
Delta			2.70E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	16.10	24.15	32.20
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

1.9.3.2 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 : 2009/12/31

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

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	4.00	4.00	4.00
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

1.10 Main Steam Isolation Valves

1.10.1PWR Main Steam Isolation Valves

1.10.1.1 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 :	2009/12/31

Total Number of Independent Failure Events: 15.80
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9148400	0.9748620	0.9852180	0.9995830	0.9848940	2.6546E+01	6.8452E-01
α_2	4.15E-04	2.51E-02	1.48E-02	8.52E-02	1.51E-02	6.8452E-01	2.6546E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9271210	0.9710140	0.9764980	0.9961420	0.9796540	5.3630E+01	1.6009E+00
α_2	1.76E-03	2.19E-02	1.64E-02	6.07E-02	1.53E-02	1.2087E+00	5.4022E+01
α_3	6.52E-06	7.10E-03	2.55E-03	2.96E-02	5.09E-03	3.9222E-01	5.4839E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9313440	0.9684260	0.9722240	0.9925010	0.9788710	7.7986E+01	2.5426E+00
α_2	2.64E-03	1.99E-02	1.61E-02	5.03E-02	1.15E-02	1.6031E+00	7.8925E+01
α_3	1.10E-04	8.13E-03	4.57E-03	2.82E-02	7.68E-03	6.5431E-01	7.9874E+01
α_4	2.37E-07	3.54E-03	7.99E-04	1.65E-02	1.92E-03	2.8517E-01	8.0243E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9417530	0.9689600	0.9711640	0.9886230	0.9799200	1.3582E+02	4.3509E+00
α_2	3.89E-03	1.73E-02	1.51E-02	3.84E-02	7.72E-03	2.4267E+00	1.3774E+02
α_3	8.31E-04	9.20E-03	7.00E-03	2.51E-02	7.72E-03	1.2899E+00	1.3888E+02
α_4	2.03E-05	3.79E-03	1.82E-03	1.42E-02	3.86E-03	5.3069E-01	1.3964E+02
α_5	1.20E-15	7.39E-04	5.42E-06	4.29E-03	7.73E-04	1.0358E-01	1.4007E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9451830	0.9695200	0.9713460	0.9876040	0.9815910	1.6443E+02	5.1694E+00
α_2	3.33E-03	1.46E-02	1.27E-02	3.22E-02	4.84E-03	2.4736E+00	1.6713E+02
α_3	9.61E-04	8.57E-03	6.74E-03	2.25E-02	6.46E-03	1.4543E+00	1.6815E+02
α_4	1.48E-04	4.87E-03	3.12E-03	1.56E-02	4.84E-03	8.2662E-01	1.6877E+02
α_5	3.18E-07	1.86E-03	4.95E-04	8.38E-03	1.94E-03	3.1600E-01	1.6928E+02
α_6	2.46E-16	5.83E-04	3.23E-06	3.39E-03	3.22E-04	9.8837E-02	1.6950E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9503810	0.9700850	0.9713450	0.9854750	0.9833460	2.3940E+02	7.3825E+00
α_2	3.87E-03	1.32E-02	1.19E-02	2.69E-02	2.92E-03	3.2519E+00	2.4353E+02
α_3	1.29E-03	7.72E-03	6.43E-03	1.85E-02	4.86E-03	1.9046E+00	2.4488E+02
α_4	4.42E-04	5.12E-03	3.86E-03	1.41E-02	4.86E-03	1.2623E+00	2.4552E+02
α_5	4.49E-05	2.78E-03	1.60E-03	9.52E-03	2.92E-03	6.8587E-01	2.4610E+02
α_6	1.09E-08	9.76E-04	1.58E-04	4.78E-03	9.72E-04	2.4098E-01	2.4654E+02
α_7	1.22E-38	1.49E-04	1.61E-11	6.83E-04	1.39E-04	3.6871E-02	2.4675E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9531740	0.9709840	0.9720570	0.9851200	0.9849680	2.8196E+02	8.4260E+00
α_2	3.67E-03	1.19E-02	1.08E-02	2.39E-02	1.70E-03	3.4541E+00	2.8693E+02
α_3	1.17E-03	6.74E-03	5.65E-03	1.60E-02	3.41E-03	1.9572E+00	2.8843E+02
α_4	5.25E-04	4.89E-03	3.81E-03	1.29E-02	4.26E-03	1.4199E+00	2.8897E+02
α_5	1.35E-04	3.19E-03	2.15E-03	9.81E-03	3.41E-03	9.2713E-01	2.8946E+02
α_6	4.97E-06	1.64E-03	7.16E-04	6.41E-03	1.70E-03	4.7636E-01	2.8991E+02
α_7	8.04E-12	5.31E-04	2.45E-05	2.91E-03	4.88E-04	1.5427E-01	2.9023E+02
α_8	1.45E-38	1.27E-04	1.48E-11	5.84E-04	6.08E-05	3.7024E-02	2.9035E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9848940	0.9796540	0.9788710	0.9799200	0.9815910	0.9833460	0.9849680
α_2	1.51E-02	1.53E-02	1.15E-02	7.72E-03	4.84E-03	2.92E-03	1.70E-03
α_3		5.09E-03	7.68E-03	7.72E-03	6.46E-03	4.86E-03	3.41E-03
α_4			1.92E-03	3.86E-03	4.84E-03	4.86E-03	4.26E-03
α_5				7.73E-04	1.94E-03	2.92E-03	3.41E-03
α_6					3.22E-04	9.72E-04	1.70E-03
α_7						1.39E-04	4.88E-04
α_8							6.08E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.85E-01	9.80E-01	9.79E-01	9.80E-01	9.82E-01	9.83E-01	9.85E-01
Beta	1.51E-02	2.03E-02	2.11E-02	2.01E-02	1.84E-02	1.67E-02	1.50E-02
Gamma		2.50E-01	4.55E-01	6.15E-01	7.37E-01	8.25E-01	8.87E-01
Delta			2.00E-01	3.75E-01	5.24E-01	6.46E-01	7.44E-01
Epsilon				1.67E-01	3.18E-01	4.53E-01	5.71E-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	15.80	23.70	31.60	39.50	47.40	55.30	63.20
N_1	0.5000	0.3750	0.2500	0.1563	0.0938	0.0547	0.0313
N_2	0.2500	0.3750	0.3750	0.3125	0.2344	0.1641	0.1094
N_3		0.1250	0.2500	0.3125	0.3125	0.2734	0.2188
N_4			0.0625	0.1563	0.2344	0.2734	0.2734
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

1.10.1.2 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 : 2009/12/31

Total Number of Independent Failure Events: 26.30
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8722360	0.9553240	0.9673570	0.9971950	0.9520950	2.2833E+01	1.0678E+00
α_2	2.80E-03	4.47E-02	3.26E-02	1.28E-01	4.79E-02	1.0678E+00	2.2833E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8864920	0.9466730	0.9525750	0.9866350	0.9186570	4.7060E+01	2.6509E+00
α_2	9.15E-03	4.44E-02	3.84E-02	1.00E-01	7.22E-02	2.2087E+00	4.7502E+01
α_3	1.77E-05	8.90E-03	3.65E-03	3.56E-02	9.18E-03	4.4222E-01	4.9269E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8868610	0.9387530	0.9427560	0.9769490	0.8945780	6.8093E+01	4.4426E+00
α_2	1.38E-02	4.55E-02	4.14E-02	9.14E-02	8.45E-02	3.3031E+00	6.9232E+01
α_3	3.99E-04	1.18E-02	7.69E-03	3.71E-02	1.83E-02	8.5431E-01	7.1681E+01
α_4	2.63E-07	3.93E-03	8.87E-04	1.83E-02	2.55E-03	2.8517E-01	7.2250E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9148130	0.9497250	0.9520290	0.9767770	0.9004790	1.2312E+02	6.5175E+00
α_2	9.61E-03	2.90E-02	2.66E-02	5.66E-02	5.50E-02	3.7600E+00	1.2588E+02
α_3	3.16E-03	1.64E-02	1.40E-02	3.79E-02	3.83E-02	2.1232E+00	1.2751E+02
α_4	2.20E-05	4.09E-03	1.97E-03	1.54E-02	5.22E-03	5.3069E-01	1.2911E+02
α_5	1.30E-15	7.99E-04	5.86E-06	4.64E-03	1.05E-03	1.0358E-01	1.2953E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9218390	0.9525950	0.9545120	0.9767990	0.9110170	1.4909E+02	7.4193E+00
α_2	5.84E-03	2.02E-02	1.82E-02	4.15E-02	2.63E-02	3.1680E+00	1.5334E+02
α_3	4.95E-03	1.85E-02	1.65E-02	3.90E-02	4.98E-02	2.8987E+00	1.5361E+02
α_4	2.62E-04	5.99E-03	4.06E-03	1.83E-02	9.79E-03	9.3772E-01	1.5557E+02
α_5	3.45E-07	2.02E-03	5.37E-04	9.08E-03	2.66E-03	3.1600E-01	1.5619E+02
α_6	2.67E-16	6.32E-04	3.50E-06	3.67E-03	4.42E-04	9.8837E-02	1.5641E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9344590	0.9581080	0.9594270	0.9772670	0.9203290	2.2145E+02	9.6826E+00
α_2	5.51E-03	1.65E-02	1.52E-02	3.23E-02	1.81E-02	3.8232E+00	2.2731E+02
α_3	3.50E-03	1.29E-02	1.15E-02	2.69E-02	3.30E-02	2.9741E+00	2.2816E+02
α_4	1.35E-03	8.15E-03	6.79E-03	1.96E-02	2.20E-02	1.8846E+00	2.2925E+02
α_5	6.12E-05	3.13E-03	1.86E-03	1.05E-02	4.95E-03	7.2287E-01	2.3041E+02
α_6	1.16E-08	1.04E-03	1.69E-04	5.10E-03	1.35E-03	2.4098E-01	2.3089E+02
α_7	1.30E-38	1.60E-04	1.72E-11	7.29E-04	1.92E-04	3.6871E-02	2.3110E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9392500	0.9603970	0.9615230	0.9777070	0.9278360	2.6138E+02	1.0778E+01
α_2	4.95E-03	1.45E-02	1.33E-02	2.81E-02	1.32E-02	3.9516E+00	2.6821E+02
α_3	2.58E-03	1.01E-02	8.98E-03	2.17E-02	2.23E-02	2.7622E+00	2.6940E+02
α_4	1.62E-03	8.08E-03	6.91E-03	1.85E-02	2.29E-02	2.1987E+00	2.6996E+02
α_5	3.31E-04	4.36E-03	3.22E-03	1.23E-02	1.04E-02	1.1858E+00	2.7097E+02
α_6	6.26E-06	1.80E-03	8.02E-04	6.95E-03	2.65E-03	4.8866E-01	2.7167E+02
α_7	8.58E-12	5.67E-04	2.62E-05	3.10E-03	6.81E-04	1.5427E-01	2.7200E+02
α_8	1.54E-38	1.36E-04	1.58E-11	6.23E-04	8.48E-05	3.7024E-02	2.7212E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9520950	0.9186570	0.8945780	0.9004790	0.9110170	0.9203290	0.9278360
α_2	4.79E-02	7.22E-02	8.45E-02	5.50E-02	2.63E-02	1.81E-02	1.32E-02
α_3		9.18E-03	1.83E-02	3.83E-02	4.98E-02	3.30E-02	2.23E-02
α_4			2.55E-03	5.22E-03	9.79E-03	2.20E-02	2.29E-02
α_5				1.05E-03	2.66E-03	4.95E-03	1.04E-02
α_6					4.42E-04	1.35E-03	2.65E-03
α_7						1.92E-04	6.81E-04
α_8							8.48E-05

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
1-Beta	9.52E-01	9.19E-01	8.95E-01	9.00E-01	9.11E-01	9.20E-01	9.28E-01
Beta	4.79E-02	8.13E-02	1.05E-01	9.95E-02	8.90E-02	7.97E-02	7.22E-02
Gamma		1.13E-01	1.98E-01	4.48E-01	7.04E-01	7.73E-01	8.17E-01
Delta			1.22E-01	1.41E-01	2.06E-01	4.63E-01	6.22E-01
Epsilon				1.67E-01	2.40E-01	2.27E-01	3.76E-01
Mu					1.43E-01	2.37E-01	2.47E-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	10.52	15.78	21.04	26.30	31.56	36.82	42.08
N_1	2.0667	1.7250	0.9167	0.6563	0.5938	0.5797	0.5713
N_2	0.6333	1.3750	2.0750	1.6458	0.9288	0.7354	0.6069
N_3		0.1750	0.4500	1.1458	1.7569	1.3429	1.0238
N_4			0.0625	0.1563	0.3455	0.8957	1.0522
N_5				0.0313	0.0938	0.2011	0.4775
N_6					0.0156	0.0547	0.1217
N_7						0.0078	0.0313
N_8							0.0039

1.10.2BWR Main Steam Isolation Valves

1.10.2.1 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 : 2009/12/31

Total Number of Independent Failure Events: 3.50
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8513580	0.9625750	0.9842830	0.9999310	1.0000000	1.1176E+01	4.3452E-01
α_2	7.04E-05	3.74E-02	1.57E-02	1.49E-01	0.00E+00	4.3452E-01	1.1176E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9022300	0.9656380	0.9747930	0.9977110	0.9999280	3.0940E+01	1.1010E+00
α_2	8.33E-04	2.60E-02	1.70E-02	8.21E-02	7.22E-05	8.3376E-01	3.1207E+01
α_3	2.94E-07	8.34E-03	1.69E-03	3.96E-02	0.00E+00	2.6722E-01	3.1774E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9110910	0.9627760	0.9687980	0.9938470	0.9998920	4.7986E+01	1.8553E+00
α_2	2.05E-03	2.46E-02	1.86E-02	6.79E-02	1.08E-04	1.2283E+00	4.8613E+01
α_3	9.16E-06	8.11E-03	3.02E-03	3.35E-02	0.00E+00	4.0431E-01	4.9437E+01
α_4	1.93E-08	4.47E-03	6.13E-04	2.24E-02	0.00E+00	2.2267E-01	4.9619E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9313770	0.9653120	0.9683150	0.9889800	0.9998270	9.8475E+01	3.5386E+00
α_2	4.00E-03	2.07E-02	1.77E-02	4.79E-02	1.73E-04	2.1146E+00	9.9899E+01
α_3	4.68E-04	9.58E-03	6.62E-03	2.88E-02	0.00E+00	9.7738E-01	1.0104E+02
α_4	2.41E-06	3.67E-03	1.24E-03	1.56E-02	0.00E+00	3.7439E-01	1.0164E+02
α_5	5.85E-21	7.09E-04	4.01E-07	4.10E-03	0.00E+00	7.2277E-02	1.0194E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9350450	0.9654900	0.9679680	0.9874670	0.9998200	1.1972E+02	4.2792E+00
α_2	3.72E-03	1.81E-02	1.55E-02	4.10E-02	1.80E-04	2.2397E+00	1.2176E+02
α_3	6.49E-04	9.21E-03	6.74E-03	2.62E-02	0.00E+00	1.1418E+00	1.2286E+02
α_4	4.27E-05	4.78E-03	2.50E-03	1.72E-02	0.00E+00	5.9222E-01	1.2341E+02
α_5	7.49E-09	1.79E-03	2.43E-04	8.98E-03	0.00E+00	2.2220E-01	1.2378E+02
α_6	1.14E-18	6.71E-04	1.17E-06	3.92E-03	0.00E+00	8.3237E-02	1.2392E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9432010	0.9667270	0.9683250	0.9848010	0.9997530	1.8728E+02	6.4458E+00
α_2	4.49E-03	1.59E-02	1.43E-02	3.30E-02	2.47E-04	3.0886E+00	1.9064E+02
α_3	1.14E-03	8.42E-03	6.80E-03	2.12E-02	0.00E+00	1.6312E+00	1.9209E+02
α_4	2.56E-04	5.10E-03	3.53E-03	1.53E-02	0.00E+00	9.8887E-01	1.9274E+02
α_5	1.32E-05	2.69E-03	1.28E-03	1.02E-02	0.00E+00	5.2177E-01	1.9320E+02
α_6	3.47E-10	9.62E-04	8.21E-05	5.05E-03	0.00E+00	1.8628E-01	1.9354E+02
α_7	0.00E+00	1.50E-04	1.31E-13	5.65E-04	0.00E+00	2.9071E-02	1.9370E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9463270	0.9675410	0.9688920	0.9841570	0.9997300	2.2243E+02	7.4620E+00
α_2	4.38E-03	1.46E-02	1.32E-02	2.95E-02	2.70E-04	3.3457E+00	2.2655E+02
α_3	1.12E-03	7.56E-03	6.19E-03	1.87E-02	0.00E+00	1.7384E+00	2.2815E+02
α_4	3.53E-04	4.99E-03	3.65E-03	1.42E-02	0.00E+00	1.1465E+00	2.2875E+02
α_5	5.61E-05	3.08E-03	1.81E-03	1.04E-02	0.00E+00	7.0833E-01	2.2918E+02
α_6	9.03E-07	1.60E-03	5.23E-04	6.83E-03	0.00E+00	3.6696E-01	2.2953E+02
α_7	7.08E-14	5.35E-04	9.62E-06	3.05E-03	0.00E+00	1.2297E-01	2.2977E+02
α_8	1.33E-42	1.44E-04	2.05E-12	6.09E-04	0.00E+00	3.3124E-02	2.2986E+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	0.9999280	0.9998920	0.9998270	0.9998200	0.9997530	0.9997300
α_2	0.00E+00	7.22E-05	1.08E-04	1.73E-04	1.80E-04	2.47E-04	2.70E-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	7.22E-05	1.08E-04	1.73E-04	1.80E-04	2.47E-04	2.70E-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	0.88	1.31	1.75	2.19	2.63	3.06	3.50
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

1.10.2.2 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 : 2009/12/31

Total Number of Independent Failure Events: 9.00
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8651700	0.9648640	0.9838790	0.9998860	0.9849080	1.3157E+01	4.7912E-01
α_2	1.16E-04	3.51E-02	1.61E-02	1.35E-01	1.51E-02	4.7912E-01	1.3157E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9036240	0.9647480	0.9731720	0.9970110	0.9693660	3.3792E+01	1.2348E+00
α_2	1.34E-03	2.76E-02	1.93E-02	8.25E-02	3.06E-02	9.6756E-01	3.4059E+01
α_3	2.69E-07	7.63E-03	1.54E-03	3.62E-02	0.00E+00	2.6722E-01	3.4760E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9095910	0.9604830	0.9660640	0.9922520	0.9532640	5.1600E+01	2.1230E+00
α_2	3.32E-03	2.78E-02	2.22E-02	7.16E-02	4.67E-02	1.4960E+00	5.2227E+01
α_3	8.49E-06	7.53E-03	2.80E-03	3.11E-02	0.00E+00	4.0431E-01	5.3319E+01
α_4	1.79E-08	4.14E-03	5.69E-04	2.08E-02	0.00E+00	2.2267E-01	5.3500E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9285140	0.9626750	0.9655350	0.9870620	0.9367570	1.0277E+02	3.9846E+00
α_2	5.71E-03	2.40E-02	2.11E-02	5.22E-02	6.32E-02	2.5606E+00	1.0419E+02
α_3	4.47E-04	9.16E-03	6.33E-03	2.75E-02	0.00E+00	9.7738E-01	1.0578E+02
α_4	2.31E-06	3.51E-03	1.18E-03	1.49E-02	0.00E+00	3.7439E-01	1.0638E+02
α_5	5.59E-21	6.77E-04	3.83E-07	3.92E-03	0.00E+00	7.2277E-02	1.0668E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9307480	0.9618040	0.9641580	0.9848090	0.9196190	1.2460E+02	4.9483E+00
α_2	6.03E-03	2.25E-02	2.00E-02	4.71E-02	8.04E-02	2.9088E+00	1.2664E+02
α_3	6.21E-04	8.81E-03	6.45E-03	2.51E-02	0.00E+00	1.1418E+00	1.2841E+02
α_4	4.09E-05	4.57E-03	2.39E-03	1.65E-02	0.00E+00	5.9222E-01	1.2896E+02
α_5	7.17E-09	1.72E-03	2.33E-04	8.59E-03	0.00E+00	2.2220E-01	1.2933E+02
α_6	1.09E-18	6.43E-04	1.12E-06	3.75E-03	0.00E+00	8.3237E-02	1.2947E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9389120	0.9630990	0.9646360	0.9820470	0.9020120	1.9268E+02	7.3825E+00
α_2	6.97E-03	2.01E-02	1.85E-02	3.87E-02	9.80E-02	4.0253E+00	1.9604E+02
α_3	1.10E-03	8.15E-03	6.58E-03	2.06E-02	0.00E+00	1.6312E+00	1.9843E+02
α_4	2.48E-04	4.94E-03	3.42E-03	1.48E-02	0.00E+00	9.8887E-01	1.9907E+02
α_5	1.28E-05	2.61E-03	1.23E-03	9.86E-03	0.00E+00	5.2177E-01	1.9954E+02
α_6	3.36E-10	9.31E-04	7.95E-05	4.89E-03	0.00E+00	1.8628E-01	1.9988E+02
α_7	0.00E+00	1.45E-04	1.27E-13	5.47E-04	0.00E+00	2.9071E-02	2.0003E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9411920	0.9632360	0.9645350	0.9808530	0.8837210	2.2823E+02	8.7110E+00
α_2	7.32E-03	1.94E-02	1.81E-02	3.60E-02	1.16E-01	4.5947E+00	2.3235E+02
α_3	1.09E-03	7.34E-03	6.00E-03	1.81E-02	0.00E+00	1.7384E+00	2.3520E+02
α_4	3.43E-04	4.84E-03	3.54E-03	1.38E-02	0.00E+00	1.1465E+00	2.3579E+02
α_5	5.44E-05	2.99E-03	1.76E-03	1.01E-02	0.00E+00	7.0833E-01	2.3623E+02
α_6	8.77E-07	1.55E-03	5.07E-04	6.62E-03	0.00E+00	3.6696E-01	2.3657E+02
α_7	6.87E-14	5.19E-04	9.33E-06	2.95E-03	0.00E+00	1.2297E-01	2.3682E+02
α_8	1.29E-42	1.40E-04	1.99E-12	5.91E-04	0.00E+00	3.3124E-02	2.3691E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9849080	0.9693660	0.9532640	0.9367570	0.9196190	0.9020120	0.8837210
α_2	1.51E-02	3.06E-02	4.67E-02	6.32E-02	8.04E-02	9.80E-02	1.16E-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	9.37E-01	9.20E-01	9.02E-01	8.84E-01
Beta	1.51E-02	3.06E-02	4.67E-02	6.32E-02	8.04E-02	9.80E-02	1.16E-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	2.25	3.38	4.50	5.63	6.75	7.88	9.00
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

1.11 Generators

1.11.1Emergency Diesel Generators

1.11.1.1 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 :	2009/12/31

Total Number of Independent Failure Events: 191.40
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9731360	0.9877550	0.9892860	0.9971370	0.9893020	2.0445E+02	2.5345E+00
α_2	2.87E-03	1.22E-02	1.07E-02	2.69E-02	1.07E-02	2.5345E+00	2.0445E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9788070	0.9895150	0.9905110	0.9968220	0.9921870	3.1908E+02	3.3809E+00
α_2	1.24E-03	6.52E-03	5.54E-03	1.52E-02	4.35E-03	2.1037E+00	3.2036E+02
α_3	3.49E-04	3.96E-03	2.99E-03	1.09E-02	3.46E-03	1.2772E+00	3.2118E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9810650	0.9899640	0.9907040	0.9963380	0.9935010	4.3185E+02	4.3781E+00
α_2	1.02E-03	5.08E-03	4.34E-03	1.16E-02	2.54E-03	2.2141E+00	4.3401E+02
α_3	3.63E-04	3.30E-03	2.58E-03	8.71E-03	2.67E-03	1.4403E+00	4.3479E+02
α_4	3.25E-05	1.66E-03	9.86E-04	5.57E-03	1.29E-03	7.2367E-01	4.3550E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9893020	0.9921870	0.9935010
α_2	1.07E-02	4.35E-03	2.54E-03
α_3		3.46E-03	2.67E-03
α_4			1.29E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.89E-01	9.92E-01	9.94E-01
Beta	1.07E-02	7.81E-03	6.50E-03
Gamma		4.43E-01	6.09E-01
Delta			3.26E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	191.40	287.10	382.80
N_1	2.8000	2.4300	2.9160
N_2	2.1000	1.2700	0.9860
N_3		1.0100	1.0360
N_4			0.5010

1.11.1.2 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 : 2009/12/31

Total Number of Independent Failure Events: 190.50
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9773540	0.9934810	0.9963370	0.9999130	0.9975410	9.9904E+01	6.5552E-01
α_2	8.91E-05	6.52E-03	3.67E-03	2.26E-02	2.46E-03	6.5552E-01	9.9904E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9738830	0.9893970	0.9913010	0.9984140	0.9951660	1.6340E+02	1.7511E+00
α_2	1.03E-03	8.95E-03	7.06E-03	2.33E-02	4.79E-03	1.4775E+00	1.6367E+02
α_3	7.33E-08	1.66E-03	3.46E-04	7.80E-03	4.76E-05	2.7362E-01	1.6488E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9715350	0.9861950	0.9875990	0.9960680	0.9928610	2.2376E+02	3.1323E+00
α_2	2.50E-03	1.09E-02	9.54E-03	2.42E-02	7.01E-03	2.4822E+00	2.2441E+02
α_3	2.97E-06	1.88E-03	7.35E-04	7.63E-03	1.25E-04	4.2661E-01	2.2647E+02
α_4	4.42E-09	9.85E-04	1.35E-04	4.93E-03	4.47E-06	2.2347E-01	2.2667E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9975410	0.9951660	0.9928610
α_2	2.46E-03	4.79E-03	7.01E-03
α_3		4.76E-05	1.25E-04
α_4			4.47E-06

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.98E-01	9.95E-01	9.93E-01
Beta	2.46E-03	4.83E-03	7.14E-03
Gamma		9.84E-03	1.81E-02
Delta			3.46E-02

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	87.99	131.99	175.98
N_1	1.6680	1.8582	1.6415
N_2	0.2210	0.6438	1.2541
N_3		0.0064	0.0223
N_4			0.0008

1.11.1.3 EMERGENCY DIESEL GENERATOR SPAR:DGN-FR

System : Emergency power supply
Component : Generator
Failure Mode : Fail to run
Component Group : Emergency Diesel Generator
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 125.10
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9724340	0.9894730	0.9917210	0.9988200	0.9919990	1.3671E+02	1.4545E+00
α_2	1.18E-03	1.05E-02	8.28E-03	2.76E-02	8.00E-03	1.4545E+00	1.3671E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9773680	0.9901890	0.9916340	0.9980750	0.9944180	2.1769E+02	2.1569E+00
α_2	6.51E-04	6.31E-03	4.89E-03	1.68E-02	2.93E-03	1.3877E+00	2.1846E+02
α_3	8.47E-05	3.50E-03	2.15E-03	1.15E-02	2.65E-03	7.6922E-01	2.1908E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9792880	0.9901300	0.9911950	0.9973310	0.9956150	2.9692E+02	2.9597E+00
α_2	6.69E-04	5.25E-03	4.20E-03	1.34E-02	1.38E-03	1.5753E+00	2.9830E+02
α_3	1.23E-04	3.04E-03	2.03E-03	9.40E-03	2.01E-03	9.1151E-01	2.9897E+02
α_4	4.59E-06	1.58E-03	6.83E-04	6.17E-03	9.93E-04	4.7287E-01	2.9941E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4
α_1	0.9919990	0.9944180	0.9956150
α_2	8.00E-03	2.93E-03	1.38E-03
α_3		2.65E-03	2.01E-03
α_4			9.93E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4
1-Beta	9.92E-01	9.94E-01	9.96E-01
Beta	8.00E-03	5.58E-03	4.39E-03
Gamma		4.75E-01	6.86E-01
Delta			3.30E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4
Adj. Ind. Events	125.10	187.65	250.20
N_1	1.3600	0.4860	0.5832
N_2	1.0200	0.5540	0.3472
N_3		0.5020	0.5072
N_4			0.2502

1.12 Vacuum Breakers

1.12.1BWR Pressure Suppression Vacuum Breakers

1.12.1.1 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 :	2009/12/31

Total Number of Independent Failure Events: 6.50
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8566110	0.9592790	0.9775730	0.9995900	0.9591760	1.4163E+01	6.0122E-01
α_2	4.09E-04	4.07E-02	2.24E-02	1.43E-01	4.08E-02	6.0122E-01	1.4163E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8906250	0.9561820	0.9642460	0.9941010	0.9149660	3.4935E+01	1.6009E+00
α_2	3.59E-03	3.65E-02	2.84E-02	9.72E-02	8.50E-02	1.3337E+00	3.5202E+01
α_3	2.57E-07	7.31E-03	1.48E-03	3.47E-02	0.00E+00	2.6722E-01	3.6269E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8927040	0.9485490	0.9538680	0.9861960	0.8666670	5.2636E+01	2.8551E+00
α_2	8.33E-03	4.02E-02	3.47E-02	9.05E-02	1.33E-01	2.2281E+00	5.3263E+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	0.9228590	0.9582990	0.9610830	0.9842280	0.8904710	1.0429E+02	4.5383E+00
α_2	6.59E-03	2.56E-02	2.27E-02	5.43E-02	7.30E-02	2.7809E+00	1.0605E+02
α_3	1.12E-03	1.20E-02	9.21E-03	3.26E-02	3.65E-02	1.3107E+00	1.0752E+02
α_4	2.26E-06	3.44E-03	1.16E-03	1.46E-02	0.00E+00	3.7439E-01	1.0845E+02
α_5	5.48E-21	6.64E-04	3.76E-07	3.85E-03	0.00E+00	7.2277E-02	1.0876E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9286410	0.9600010	0.9623050	0.9834780	0.9069850	1.2669E+02	5.2786E+00
α_2	5.06E-03	2.03E-02	1.80E-02	4.37E-02	4.13E-02	2.6836E+00	1.2928E+02
α_3	1.56E-03	1.20E-02	9.66E-03	3.06E-02	4.13E-02	1.5862E+00	1.3038E+02
α_4	9.48E-05	5.33E-03	3.13E-03	1.81E-02	1.03E-02	7.0332E-01	1.3127E+02
α_5	7.04E-09	1.68E-03	2.28E-04	8.44E-03	0.00E+00	2.2220E-01	1.3175E+02
α_6	1.07E-18	6.31E-04	1.10E-06	3.68E-03	0.00E+00	8.3237E-02	1.3189E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9591760	0.9149660	0.8666670	0.8904710	0.9069850
α_2	4.08E-02	8.50E-02	1.33E-01	7.30E-02	4.13E-02
α_3		0.00E+00	0.00E+00	3.65E-02	4.13E-02
α_4			0.00E+00	0.00E+00	1.03E-02
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	9.59E-01	9.15E-01	8.67E-01	8.90E-01	9.07E-01
Beta	4.08E-02	8.50E-02	1.33E-01	1.10E-01	9.30E-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	3.25	4.88	6.50	8.13	9.75
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

1.13 AC Power Distribution Breakers

1.13.1480 Vac Circuit Breakers

1.13.1.1 480 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 :	2009/12/31

Total Number of Independent Failure Events: 12.20
Total Number of Common-Cause Failure Events: 3

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8569670	0.9631330	0.9835330	0.9999000	0.9845840	1.2117E+01	4.6382E-01
α_2	1.02E-04	3.69E-02	1.65E-02	1.43E-01	1.54E-02	4.6382E-01	1.2117E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9020750	0.9647310	0.9735280	0.9972720	0.9717420	3.2282E+01	1.1802E+00
α_2	1.11E-03	2.72E-02	1.84E-02	8.30E-02	2.67E-02	9.0866E-01	3.2554E+01
α_3	3.37E-07	8.11E-03	1.69E-03	3.83E-02	1.53E-03	2.7152E-01	3.3191E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9098400	0.9613370	0.9671440	0.9929600	0.9612270	4.9684E+01	1.9982E+00
α_2	2.64E-03	2.62E-02	2.04E-02	6.98E-02	3.46E-02	1.3557E+00	5.0326E+01
α_3	1.16E-05	8.11E-03	3.14E-03	3.31E-02	4.04E-03	4.1921E-01	5.1263E+01
α_4	1.93E-08	4.32E-03	5.97E-04	2.16E-02	1.63E-04	2.2327E-01	5.1459E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9299200	0.9639950	0.9669240	0.9880420	0.9527340	1.0050E+02	3.7537E+00
α_2	4.66E-03	2.20E-02	1.90E-02	4.96E-02	3.96E-02	2.2948E+00	1.0196E+02
α_3	5.13E-04	9.68E-03	6.78E-03	2.88E-02	7.04E-03	1.0095E+00	1.0324E+02
α_4	2.50E-06	3.62E-03	1.23E-03	1.53E-02	5.71E-04	3.7699E-01	1.0388E+02
α_5	6.06E-21	6.94E-04	3.97E-07	4.02E-03	2.19E-05	7.2377E-02	1.0418E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9332260	0.9639100	0.9663270	0.9863230	0.9461430	1.2207E+02	4.5705E+00
α_2	4.46E-03	1.95E-02	1.70E-02	4.30E-02	4.24E-02	2.4687E+00	1.2417E+02
α_3	7.36E-04	9.45E-03	7.02E-03	2.65E-02	1.02E-02	1.1969E+00	1.2544E+02
α_4	4.45E-05	4.73E-03	2.50E-03	1.70E-02	1.26E-03	5.9902E-01	1.2604E+02
α_5	7.52E-09	1.76E-03	2.39E-04	8.80E-03	7.38E-05	2.2260E-01	1.2642E+02
α_6	1.11E-18	6.57E-04	1.15E-06	3.84E-03	0.00E+00	8.3237E-02	1.2656E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9416240	0.9653650	0.9669290	0.9837550	0.9409400	1.8994E+02	6.8145E+00
α_2	5.16E-03	1.71E-02	1.55E-02	3.45E-02	4.34E-02	3.3595E+00	1.9340E+02
α_3	1.26E-03	8.71E-03	7.11E-03	2.16E-02	1.32E-02	1.7138E+00	1.9504E+02
α_4	2.64E-04	5.10E-03	3.55E-03	1.52E-02	2.21E-03	1.0027E+00	1.9575E+02
α_5	1.32E-05	2.66E-03	1.26E-03	1.00E-02	2.08E-04	5.2307E-01	1.9623E+02
α_6	3.45E-10	9.47E-04	8.10E-05	4.97E-03	1.60E-05	1.8638E-01	1.9657E+02
α_7	0.00E+00	1.48E-04	1.29E-13	5.56E-04	0.00E+00	2.9071E-02	1.9673E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9446540	0.9661050	0.9674280	0.9830370	0.9370500	2.2537E+02	7.9069E+00
α_2	5.04E-03	1.56E-02	1.43E-02	3.09E-02	4.32E-02	3.6504E+00	2.2963E+02
α_3	1.28E-03	7.94E-03	6.58E-03	1.92E-02	1.60E-02	1.8516E+00	2.3143E+02
α_4	3.71E-04	5.02E-03	3.69E-03	1.42E-02	3.36E-03	1.1703E+00	2.3211E+02
α_5	5.64E-05	3.05E-03	1.80E-03	1.03E-02	4.24E-04	7.1133E-01	2.3257E+02
α_6	8.94E-07	1.57E-03	5.16E-04	6.73E-03	2.82E-05	3.6716E-01	2.3291E+02
α_7	6.98E-14	5.27E-04	9.48E-06	3.00E-03	0.00E+00	1.2297E-01	2.3315E+02
α_8	1.31E-42	1.42E-04	2.02E-12	6.00E-04	0.00E+00	3.3124E-02	2.3324E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9845840	0.9717420	0.9612270	0.9527340	0.9461430	0.9409400	0.9370500
α_2	1.54E-02	2.67E-02	3.46E-02	3.96E-02	4.24E-02	4.34E-02	4.32E-02
α_3		1.53E-03	4.04E-03	7.04E-03	1.02E-02	1.32E-02	1.60E-02
α_4			1.63E-04	5.71E-04	1.26E-03	2.21E-03	3.36E-03
α_5				2.19E-05	7.38E-05	2.08E-04	4.24E-04
α_6					0.00E+00	1.60E-05	2.82E-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	9.85E-01	9.72E-01	9.61E-01	9.53E-01	9.46E-01	9.41E-01	9.37E-01
Beta	1.54E-02	2.83E-02	3.88E-02	4.73E-02	5.39E-02	5.91E-02	6.29E-02
Gamma		5.42E-02	1.08E-01	1.62E-01	2.14E-01	2.65E-01	3.14E-01
Delta			3.87E-02	7.76E-02	1.16E-01	1.55E-01	1.93E-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	1.53	2.29	3.05	3.81	4.58	5.34	6.10
N_1	0.3413	0.4370	0.4976	0.5318	0.5463	0.5468	0.5375
N_2	0.0293	0.0750	0.1276	0.1806	0.2295	0.2717	0.3057
N_3		0.0043	0.0149	0.0321	0.0551	0.0826	0.1132
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

1.13.1.2 480 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 :	2009/12/31

Total Number of Independent Failure Events: 47.10
Total Number of Common-Cause Failure Events: 1

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8937690	0.9728420	0.9881360	0.9999320	0.9959940	1.6461E+01	4.5952E-01
α_2	7.00E-05	2.72E-02	1.19E-02	1.06E-01	4.01E-03	4.5952E-01	1.6461E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9181350	0.9706750	0.9781100	0.9977720	0.9923380	3.8803E+01	1.1723E+00
α_2	9.08E-04	2.26E-02	1.53E-02	6.94E-02	7.47E-03	9.0326E-01	3.9072E+01
α_3	2.53E-07	6.73E-03	1.38E-03	3.19E-02	1.93E-04	2.6902E-01	3.9706E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9228250	0.9670280	0.9720460	0.9940480	0.9890450	5.8387E+01	1.9908E+00
α_2	2.26E-03	2.25E-02	1.74E-02	5.99E-02	1.04E-02	1.3567E+00	5.9021E+01
α_3	8.61E-06	6.81E-03	2.58E-03	2.80E-02	5.73E-04	4.1141E-01	5.9966E+01
α_4	1.59E-08	3.69E-03	5.05E-04	1.85E-02	0.00E+00	2.2267E-01	6.0155E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9364710	0.9674040	0.9700750	0.9891950	0.9861070	1.1137E+02	3.7525E+00
α_2	4.28E-03	2.01E-02	1.74E-02	4.51E-02	1.27E-02	2.3106E+00	1.1281E+02
α_3	4.42E-04	8.65E-03	6.02E-03	2.58E-02	1.16E-03	9.9528E-01	1.1413E+02
α_4	2.14E-06	3.25E-03	1.10E-03	1.38E-02	0.00E+00	3.7439E-01	1.1475E+02
α_5	5.18E-21	6.28E-04	3.55E-07	3.63E-03	0.00E+00	7.2277E-02	1.1505E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9392680	0.9671900	0.9693970	0.9875640	0.9835410	1.3508E+02	4.5823E+00
α_2	4.17E-03	1.80E-02	1.57E-02	3.94E-02	1.45E-02	2.5071E+00	1.3716E+02
α_3	6.34E-04	8.43E-03	6.23E-03	2.38E-02	1.94E-03	1.1775E+00	1.3848E+02
α_4	3.79E-05	4.24E-03	2.22E-03	1.53E-02	0.00E+00	5.9222E-01	1.3907E+02
α_5	6.65E-09	1.59E-03	2.16E-04	7.97E-03	0.00E+00	2.2220E-01	1.3944E+02
α_6	1.01E-18	5.96E-04	1.04E-06	3.48E-03	0.00E+00	8.3237E-02	1.3958E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9455890	0.9677050	0.9691700	0.9848290	0.9813610	2.0511E+02	6.8450E+00
α_2	4.96E-03	1.62E-02	1.47E-02	3.25E-02	1.57E-02	3.4253E+00	2.0853E+02
α_3	1.14E-03	7.99E-03	6.51E-03	1.99E-02	2.91E-03	1.6937E+00	2.1026E+02
α_4	2.34E-04	4.67E-03	3.23E-03	1.40E-02	0.00E+00	9.8887E-01	2.1097E+02
α_5	1.21E-05	2.46E-03	1.17E-03	9.30E-03	0.00E+00	5.2177E-01	2.1143E+02
α_6	3.17E-10	8.79E-04	7.50E-05	4.61E-03	0.00E+00	1.8628E-01	2.1177E+02
α_7	0.00E+00	1.37E-04	1.20E-13	5.16E-04	0.00E+00	2.9071E-02	2.1193E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9481760	0.9682380	0.9694790	0.9840700	0.9795500	2.4268E+02	7.9610E+00
α_2	4.90E-03	1.49E-02	1.37E-02	2.93E-02	1.64E-02	3.7447E+00	2.4690E+02
α_3	1.17E-03	7.33E-03	6.07E-03	1.78E-02	4.09E-03	1.8384E+00	2.4880E+02
α_4	3.24E-04	4.57E-03	3.34E-03	1.30E-02	0.00E+00	1.1465E+00	2.4949E+02
α_5	5.14E-05	2.83E-03	1.66E-03	9.56E-03	0.00E+00	7.0833E-01	2.4993E+02
α_6	8.28E-07	1.46E-03	4.79E-04	6.26E-03	0.00E+00	3.6696E-01	2.5027E+02
α_7	6.50E-14	4.91E-04	8.82E-06	2.79E-03	0.00E+00	1.2297E-01	2.5052E+02
α_8	1.22E-42	1.32E-04	1.88E-12	5.58E-04	0.00E+00	3.3124E-02	2.5061E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9959940	0.9923380	0.9890450	0.9861070	0.9835410	0.9813610	0.9795500
α_2	4.01E-03	7.47E-03	1.04E-02	1.27E-02	1.45E-02	1.57E-02	1.64E-02
α_3		1.93E-04	5.73E-04	1.16E-03	1.94E-03	2.91E-03	4.09E-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	9.96E-01	9.92E-01	9.89E-01	9.86E-01	9.84E-01	9.81E-01	9.80E-01
Beta	4.01E-03	7.66E-03	1.10E-02	1.39E-02	1.65E-02	1.86E-02	2.04E-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	5.89	8.83	11.78	14.72	17.66	20.61	23.55
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

1.13.1.3 480 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 : 2009/12/31

Total Number of Independent Failure Events: 41.70
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9666160	0.9917050	0.9966670	0.9999840	1.0000000	5.1946E+01	4.3452E-01
α_2	1.49E-05	8.30E-03	3.34E-03	3.34E-02	0.00E+00	4.3452E-01	5.1946E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9562690	0.9847850	0.9889640	0.9990030	1.0000000	7.1255E+01	1.1009E+00
α_2	3.63E-04	1.15E-02	7.44E-03	3.66E-02	0.00E+00	8.3366E-01	7.1522E+01
α_3	1.29E-07	3.69E-03	7.41E-04	1.75E-02	0.00E+00	2.6722E-01	7.2089E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9502160	0.9793170	0.9827670	0.9966230	1.0000000	8.7836E+01	1.8551E+00
α_2	1.13E-03	1.37E-02	1.03E-02	3.79E-02	0.00E+00	1.2281E+00	8.8463E+01
α_3	5.06E-06	4.51E-03	1.67E-03	1.86E-02	0.00E+00	4.0431E-01	8.9287E+01
α_4	1.07E-08	2.48E-03	3.39E-04	1.24E-02	0.00E+00	2.2267E-01	8.9468E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9503170	0.9749770	0.9771860	0.9920940	1.0000000	1.3786E+02	3.5382E+00
α_2	2.87E-03	1.50E-02	1.27E-02	3.46E-02	0.00E+00	2.1142E+00	1.3928E+02
α_3	3.37E-04	6.91E-03	4.77E-03	2.08E-02	0.00E+00	9.7738E-01	1.4042E+02
α_4	1.74E-06	2.65E-03	8.91E-04	1.12E-02	0.00E+00	3.7439E-01	1.4102E+02
α_5	4.22E-21	5.11E-04	2.89E-07	2.96E-03	0.00E+00	7.2277E-02	1.4133E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9504290	0.9737370	0.9756560	0.9904980	1.0000000	1.5864E+02	4.2787E+00
α_2	2.82E-03	1.37E-02	1.18E-02	3.13E-02	0.00E+00	2.2392E+00	1.6068E+02
α_3	4.93E-04	7.01E-03	5.12E-03	2.00E-02	0.00E+00	1.1418E+00	1.6178E+02
α_4	3.25E-05	3.64E-03	1.90E-03	1.31E-02	0.00E+00	5.9222E-01	1.6233E+02
α_5	5.70E-09	1.36E-03	1.85E-04	6.83E-03	0.00E+00	2.2220E-01	1.6270E+02
α_6	8.65E-19	5.11E-04	8.93E-07	2.98E-03	0.00E+00	8.3237E-02	1.6284E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9525430	0.9722430	0.9735910	0.9873510	1.0000000	2.2575E+02	6.4450E+00
α_2	3.74E-03	1.33E-02	1.19E-02	2.75E-02	0.00E+00	3.0878E+00	2.2911E+02
α_3	9.46E-04	7.03E-03	5.67E-03	1.77E-02	0.00E+00	1.6312E+00	2.3056E+02
α_4	2.13E-04	4.26E-03	2.95E-03	1.28E-02	0.00E+00	9.8887E-01	2.3121E+02
α_5	1.10E-05	2.25E-03	1.06E-03	8.49E-03	0.00E+00	5.2177E-01	2.3167E+02
α_6	2.89E-10	8.02E-04	6.85E-05	4.21E-03	0.00E+00	1.8628E-01	2.3201E+02
α_7	0.00E+00	1.25E-04	1.10E-13	4.71E-04	0.00E+00	2.9071E-02	2.3217E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9538880	0.9721490	0.9733140	0.9864240	1.0000000	2.6043E+02	7.4610E+00
α_2	3.75E-03	1.25E-02	1.13E-02	2.53E-02	0.00E+00	3.3447E+00	2.6455E+02
α_3	9.60E-04	6.49E-03	5.31E-03	1.61E-02	0.00E+00	1.7384E+00	2.6615E+02
α_4	3.03E-04	4.28E-03	3.13E-03	1.22E-02	0.00E+00	1.1465E+00	2.6674E+02
α_5	4.81E-05	2.64E-03	1.55E-03	8.95E-03	0.00E+00	7.0833E-01	2.6718E+02
α_6	7.75E-07	1.37E-03	4.48E-04	5.86E-03	0.00E+00	3.6696E-01	2.6752E+02
α_7	6.08E-14	4.59E-04	8.25E-06	2.61E-03	0.00E+00	1.2297E-01	2.6777E+02
α_8	1.14E-42	1.24E-04	1.76E-12	5.22E-04	0.00E+00	3.3124E-02	2.6786E+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	41.70	41.70	41.70	41.70	41.70	41.70	41.70
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

1.13.24160 vac and 6.9Kva Distribution Circuit Breakers

1.13.2.1 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 :	2009/12/31

Total Number of Independent Failure Events: 13.10
Total Number of Common-Cause Failure Events: 2

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8652340	0.9649380	0.9839770	0.9998890	0.9854700	1.3128E+01	4.7702E-01
α_2	1.13E-04	3.51E-02	1.60E-02	1.35E-01	1.45E-02	4.7702E-01	1.3128E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9038740	0.9649100	0.9733480	0.9970590	0.9707210	3.3762E+01	1.2278E+00
α_2	1.31E-03	2.74E-02	1.91E-02	8.22E-02	2.92E-02	9.6026E-01	3.4030E+01
α_3	2.72E-07	7.65E-03	1.55E-03	3.63E-02	6.92E-05	2.6752E-01	3.4722E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9099680	0.9607400	0.9663330	0.9923650	0.9556340	5.1575E+01	2.1076E+00
α_2	3.23E-03	2.76E-02	2.19E-02	7.12E-02	4.41E-02	1.4793E+00	5.2203E+01
α_3	8.71E-06	7.56E-03	2.82E-03	3.12E-02	2.28E-04	4.0561E-01	5.3277E+01
α_4	1.79E-08	4.15E-03	5.69E-04	2.08E-02	0.00E+00	2.2267E-01	5.3460E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9288440	0.9629180	0.9657800	0.9872090	0.9402440	1.0275E+02	3.9569E+00
α_2	5.58E-03	2.37E-02	2.08E-02	5.18E-02	5.93E-02	2.5299E+00	1.0418E+02
α_3	4.52E-04	9.19E-03	6.36E-03	2.76E-02	4.28E-04	9.8038E-01	1.0573E+02
α_4	2.31E-06	3.51E-03	1.18E-03	1.49E-02	0.00E+00	3.7439E-01	1.0633E+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	0.9311890	0.9621350	0.9644910	0.9850170	0.9245270	1.2460E+02	4.9037E+00
α_2	5.83E-03	2.21E-02	1.97E-02	4.66E-02	7.47E-02	2.8582E+00	1.2665E+02
α_3	6.31E-04	8.86E-03	6.49E-03	2.52E-02	7.12E-04	1.1477E+00	1.2836E+02
α_4	4.09E-05	4.57E-03	2.40E-03	1.65E-02	1.21E-05	5.9232E-01	1.2891E+02
α_5	7.17E-09	1.72E-03	2.33E-04	8.60E-03	0.00E+00	2.2220E-01	1.2928E+02
α_6	1.09E-18	6.43E-04	1.12E-06	3.75E-03	0.00E+00	8.3237E-02	1.2942E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9393260	0.9634210	0.9649600	0.9822750	0.9084560	1.9269E+02	7.3160E+00
α_2	6.74E-03	1.97E-02	1.82E-02	3.81E-02	9.05E-02	3.9484E+00	1.9606E+02
α_3	1.12E-03	8.21E-03	6.63E-03	2.07E-02	1.06E-03	1.6413E+00	1.9836E+02
α_4	2.48E-04	4.95E-03	3.42E-03	1.48E-02	3.15E-05	9.8917E-01	1.9902E+02
α_5	1.28E-05	2.61E-03	1.24E-03	9.86E-03	0.00E+00	5.2177E-01	1.9948E+02
α_6	3.36E-10	9.31E-04	7.95E-05	4.89E-03	0.00E+00	1.8628E-01	1.9982E+02
α_7	0.00E+00	1.45E-04	1.27E-13	5.47E-04	0.00E+00	2.9071E-02	1.9998E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9416830	0.9636260	0.9649210	0.9811390	0.8920460	2.2828E+02	8.6169E+00
α_2	7.04E-03	1.89E-02	1.76E-02	3.54E-02	1.06E-01	4.4843E+00	2.3241E+02
α_3	1.11E-03	7.40E-03	6.07E-03	1.83E-02	1.47E-03	1.7541E+00	2.3514E+02
α_4	3.43E-04	4.84E-03	3.54E-03	1.38E-02	5.60E-05	1.1471E+00	2.3575E+02
α_5	5.44E-05	2.99E-03	1.76E-03	1.01E-02	0.00E+00	7.0833E-01	2.3619E+02
α_6	8.77E-07	1.55E-03	5.07E-04	6.63E-03	0.00E+00	3.6696E-01	2.3653E+02
α_7	6.87E-14	5.19E-04	9.34E-06	2.96E-03	0.00E+00	1.2297E-01	2.3677E+02
α_8	1.29E-42	1.40E-04	1.99E-12	5.91E-04	0.00E+00	3.3124E-02	2.3686E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9854700	0.9707210	0.9556340	0.9402440	0.9245270	0.9084560	0.8920460
α_2	1.45E-02	2.92E-02	4.41E-02	5.93E-02	7.47E-02	9.05E-02	1.06E-01
α_3		6.92E-05	2.28E-04	4.28E-04	7.12E-04	1.06E-03	1.47E-03
α_4			0.00E+00	0.00E+00	1.21E-05	3.15E-05	5.60E-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	9.85E-01	9.71E-01	9.56E-01	9.40E-01	9.25E-01	9.08E-01	8.92E-01
Beta	1.45E-02	2.93E-02	4.44E-02	5.98E-02	7.55E-02	9.15E-02	1.08E-01
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	2.18	3.28	4.37	5.46	6.55	7.64	8.73
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

1.13.2.2 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 : 2009/12/31

Total Number of Independent Failure Events: 57.80
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9744490	0.9936550	0.9974540	0.9999870	1.0000000	6.8046E+01	4.3452E-01
α_2	1.13E-05	6.35E-03	2.54E-03	2.56E-02	0.00E+00	4.3452E-01	6.8046E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9641770	0.9875540	0.9909930	0.9991860	1.0000000	8.7355E+01	1.1009E+00
α_2	2.96E-04	9.42E-03	6.07E-03	3.00E-02	0.00E+00	8.3366E-01	8.7622E+01
α_3	1.05E-07	3.02E-03	6.05E-04	1.43E-02	0.00E+00	2.6722E-01	8.8189E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9577330	0.9824650	0.9854070	0.9971430	1.0000000	1.0394E+02	1.8551E+00
α_2	9.54E-04	1.16E-02	8.71E-03	3.22E-02	0.00E+00	1.2281E+00	1.0457E+02
α_3	4.28E-06	3.82E-03	1.41E-03	1.58E-02	0.00E+00	4.0431E-01	1.0539E+02
α_4	9.05E-09	2.10E-03	2.87E-04	1.05E-02	0.00E+00	2.2267E-01	1.0557E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9553590	0.9775350	0.9795240	0.9929100	1.0000000	1.5396E+02	3.5382E+00
α_2	2.58E-03	1.34E-02	1.14E-02	3.11E-02	0.00E+00	2.1142E+00	1.5538E+02
α_3	3.02E-04	6.21E-03	4.28E-03	1.87E-02	0.00E+00	9.7738E-01	1.5652E+02
α_4	1.56E-06	2.38E-03	7.99E-04	1.01E-02	0.00E+00	3.7439E-01	1.5712E+02
α_5	3.78E-21	4.59E-04	2.59E-07	2.65E-03	0.00E+00	7.2277E-02	1.5743E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9548460	0.9760990	0.9778540	0.9913660	1.0000000	1.7474E+02	4.2787E+00
α_2	2.56E-03	1.25E-02	1.07E-02	2.85E-02	0.00E+00	2.2392E+00	1.7678E+02
α_3	4.48E-04	6.38E-03	4.66E-03	1.82E-02	0.00E+00	1.1418E+00	1.7788E+02
α_4	2.95E-05	3.31E-03	1.73E-03	1.19E-02	0.00E+00	5.9222E-01	1.7843E+02
α_5	5.18E-09	1.24E-03	1.68E-04	6.22E-03	0.00E+00	2.2220E-01	1.7880E+02
α_6	7.87E-19	4.65E-04	8.13E-07	2.71E-03	0.00E+00	8.3237E-02	1.7894E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9555930	0.9740430	0.9753090	0.9881790	1.0000000	2.4185E+02	6.4450E+00
α_2	3.50E-03	1.24E-02	1.12E-02	2.58E-02	0.00E+00	3.0878E+00	2.4521E+02
α_3	8.84E-04	6.57E-03	5.30E-03	1.66E-02	0.00E+00	1.6312E+00	2.4666E+02
α_4	1.99E-04	3.98E-03	2.76E-03	1.20E-02	0.00E+00	9.8887E-01	2.4731E+02
α_5	1.03E-05	2.10E-03	9.94E-04	7.94E-03	0.00E+00	5.2177E-01	2.4777E+02
α_6	2.71E-10	7.50E-04	6.40E-05	3.94E-03	0.00E+00	1.8628E-01	2.4811E+02
α_7	0.00E+00	1.17E-04	1.02E-13	4.41E-04	0.00E+00	2.9071E-02	2.4827E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9564830	0.9737280	0.9748350	0.9872040	1.0000000	2.7653E+02	7.4610E+00
α_2	3.54E-03	1.18E-02	1.07E-02	2.39E-02	0.00E+00	3.3447E+00	2.8065E+02
α_3	9.05E-04	6.12E-03	5.01E-03	1.51E-02	0.00E+00	1.7384E+00	2.8225E+02
α_4	2.86E-04	4.04E-03	2.95E-03	1.15E-02	0.00E+00	1.1465E+00	2.8284E+02
α_5	4.54E-05	2.49E-03	1.47E-03	8.44E-03	0.00E+00	7.0833E-01	2.8328E+02
α_6	7.31E-07	1.29E-03	4.23E-04	5.53E-03	0.00E+00	3.6696E-01	2.8362E+02
α_7	5.73E-14	4.33E-04	7.78E-06	2.46E-03	0.00E+00	1.2297E-01	2.8387E+02
α_8	1.07E-42	1.17E-04	1.66E-12	4.93E-04	0.00E+00	3.3124E-02	2.8396E+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	57.80	57.80	57.80	57.80	57.80	57.80	57.80
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

1.13.2.3 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 :	2009/12/31

Total Number of Independent Failure Events: 28.50
Total Number of Common-Cause Failure Events: 4

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.8777900	0.9668230	0.9832950	0.9998050	0.9813450	1.5664E+01	5.3752E-01
α_2	1.98E-04	3.32E-02	1.67E-02	1.22E-01	1.87E-02	5.3752E-01	1.5664E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9051920	0.9637480	0.9714020	0.9960820	0.9624690	3.7379E+01	1.4060E+00
α_2	2.08E-03	2.93E-02	2.17E-02	8.27E-02	3.73E-02	1.1369E+00	3.7648E+01
α_3	2.62E-07	6.94E-03	1.42E-03	3.28E-02	2.34E-04	2.6912E-01	3.8516E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9083360	0.9580830	0.9631970	0.9903280	0.9433630	5.6172E+01	2.4576E+00
α_2	5.00E-03	3.11E-02	2.59E-02	7.49E-02	5.59E-02	1.8229E+00	5.6807E+01
α_3	8.97E-06	7.03E-03	2.66E-03	2.88E-02	7.24E-04	4.1201E-01	5.8218E+01
α_4	1.64E-08	3.80E-03	5.20E-04	1.90E-02	0.00E+00	2.2267E-01	5.8407E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9256130	0.9598300	0.9625220	0.9848350	0.9240950	1.0823E+02	4.5295E+00
α_2	7.76E-03	2.74E-02	2.46E-02	5.64E-02	7.44E-02	3.0863E+00	1.0967E+02
α_3	4.53E-04	8.84E-03	6.15E-03	2.64E-02	1.47E-03	9.9658E-01	1.1176E+02
α_4	2.18E-06	3.32E-03	1.12E-03	1.41E-02	0.00E+00	3.7439E-01	1.1239E+02
α_5	5.29E-21	6.41E-04	3.62E-07	3.71E-03	0.00E+00	7.2277E-02	1.1269E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9264760	0.9579300	0.9601480	0.9817960	0.9045340	1.3085E+02	5.7466E+00
α_2	8.73E-03	2.69E-02	2.46E-02	5.28E-02	9.30E-02	3.6687E+00	1.3293E+02
α_3	6.53E-04	8.64E-03	6.39E-03	2.43E-02	2.49E-03	1.1801E+00	1.3542E+02
α_4	3.88E-05	4.34E-03	2.27E-03	1.56E-02	6.50E-06	5.9232E-01	1.3600E+02
α_5	6.80E-09	1.63E-03	2.21E-04	8.15E-03	0.00E+00	2.2220E-01	1.3637E+02
α_6	1.03E-18	6.09E-04	1.07E-06	3.56E-03	0.00E+00	8.3237E-02	1.3651E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9370230	0.9612170	0.9626860	0.9803880	0.9078380	2.0009E+02	8.0731E+00
α_2	7.91E-03	2.14E-02	1.99E-02	4.00E-02	7.70E-02	4.4489E+00	2.0371E+02
α_3	1.52E-03	9.12E-03	7.60E-03	2.19E-02	1.51E-02	1.8980E+00	2.0627E+02
α_4	2.38E-04	4.75E-03	3.29E-03	1.43E-02	1.13E-05	9.8907E-01	2.0717E+02
α_5	1.23E-05	2.51E-03	1.19E-03	9.47E-03	0.00E+00	5.2177E-01	2.0764E+02
α_6	3.23E-10	8.95E-04	7.64E-05	4.70E-03	0.00E+00	1.8628E-01	2.0798E+02
α_7	0.00E+00	1.40E-04	1.22E-13	5.26E-04	0.00E+00	2.9071E-02	2.0813E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9405450	0.9623650	0.9636140	0.9799260	0.9095910	2.3686E+02	9.2629E+00
α_2	7.26E-03	1.90E-02	1.77E-02	3.52E-02	6.70E-02	4.6796E+00	2.4144E+02
α_3	1.73E-03	8.80E-03	7.51E-03	2.03E-02	2.14E-02	2.1650E+00	2.4396E+02
α_4	3.67E-04	4.82E-03	3.57E-03	1.36E-02	2.03E-03	1.1869E+00	2.4494E+02
α_5	5.24E-05	2.88E-03	1.69E-03	9.74E-03	0.00E+00	7.0833E-01	2.4541E+02
α_6	8.44E-07	1.49E-03	4.88E-04	6.38E-03	0.00E+00	3.6696E-01	2.4576E+02
α_7	6.62E-14	5.00E-04	8.98E-06	2.84E-03	0.00E+00	1.2297E-01	2.4600E+02
α_8	1.24E-42	1.35E-04	1.92E-12	5.69E-04	0.00E+00	3.3124E-02	2.4609E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6	CCCG=7	CCCG=8
α_1	0.9813450	0.9624690	0.9433630	0.9240950	0.9045340	0.9078380	0.9095910
α_2	1.87E-02	3.73E-02	5.59E-02	7.44E-02	9.30E-02	7.70E-02	6.70E-02
α_3		2.34E-04	7.24E-04	1.47E-03	2.49E-03	1.51E-02	2.14E-02
α_4			0.00E+00	0.00E+00	6.50E-06	1.13E-05	2.03E-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	9.81E-01	9.62E-01	9.43E-01	9.24E-01	9.05E-01	9.08E-01	9.10E-01
Beta	1.87E-02	3.75E-02	5.66E-02	7.59E-02	9.55E-02	9.22E-02	9.04E-02
Gamma		6.23E-03	1.28E-02	1.94E-02	2.62E-02	1.64E-01	2.59E-01
Delta			0.00E+00	0.00E+00	2.60E-03	7.49E-04	8.65E-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	4.22	6.33	8.44	10.56	12.67	14.78	16.89
N_1	1.1982	1.4941	1.5955	1.5084	1.2382	1.2576	1.2387
N_2	0.1030	0.3032	0.5948	0.9721	1.4295	1.3611	1.3349
N_3		0.0019	0.0077	0.0192	0.0383	0.2668	0.4266
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

1.14 DC Power System - Batteries, Chargers, and Breakers

1.14.1Batteries

1.14.1.1 DC POWER BATTERY NO OUTPUT SPAR:BAT-LP

System :	dc power
Component :	Battery
Failure Mode :	No voltage/amperage output
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 21.70
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9461090	0.9865810	0.9945600	0.9999730	1.0000000	3.1946E+01	4.3452E-01
α_2	2.42E-05	1.34E-02	5.44E-03	5.39E-02	0.00E+00	4.3452E-01	3.1946E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9397490	0.9789730	0.9847000	0.9986200	1.0000000	5.1255E+01	1.1009E+00
α_2	5.04E-04	1.59E-02	1.03E-02	5.05E-02	0.00E+00	8.3366E-01	5.1522E+01
α_3	1.79E-07	5.10E-03	1.03E-03	2.42E-02	0.00E+00	2.6722E-01	5.2089E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9361090	0.9733810	0.9777740	0.9956300	1.0000000	6.7836E+01	1.8551E+00
α_2	1.46E-03	1.76E-02	1.33E-02	4.87E-02	0.00E+00	1.2281E+00	6.8463E+01
α_3	6.53E-06	5.80E-03	2.15E-03	2.40E-02	0.00E+00	4.0431E-01	6.9287E+01
α_4	1.38E-08	3.20E-03	4.37E-04	1.60E-02	0.00E+00	2.2267E-01	6.9468E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9422200	0.9708540	0.9734060	0.9907670	1.0000000	1.1786E+02	3.5382E+00
α_2	3.35E-03	1.74E-02	1.48E-02	4.03E-02	0.00E+00	2.1142E+00	1.1928E+02
α_3	3.93E-04	8.05E-03	5.56E-03	2.42E-02	0.00E+00	9.7738E-01	1.2042E+02
α_4	2.03E-06	3.08E-03	1.04E-03	1.31E-02	0.00E+00	3.7439E-01	1.2102E+02
α_5	4.91E-21	5.95E-04	3.37E-07	3.45E-03	0.00E+00	7.2277E-02	1.2133E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9435640	0.9700620	0.9722320	0.9891510	1.0000000	1.3864E+02	4.2787E+00
α_2	3.22E-03	1.57E-02	1.35E-02	3.56E-02	0.00E+00	2.2392E+00	1.4068E+02
α_3	5.62E-04	7.99E-03	5.84E-03	2.28E-02	0.00E+00	1.1418E+00	1.4178E+02
α_4	3.70E-05	4.14E-03	2.17E-03	1.50E-02	0.00E+00	5.9222E-01	1.4233E+02
α_5	6.50E-09	1.55E-03	2.11E-04	7.79E-03	0.00E+00	2.2220E-01	1.4270E+02
α_6	9.86E-19	5.82E-04	1.02E-06	3.40E-03	0.00E+00	8.3237E-02	1.4284E+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	21.70	21.70	21.70	21.70	21.70
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

1.14.2 Battery Chargers

1.14.2.1 DC POWER BATTERY CHARGER LOSS OF FUNCTION SPAR: BCH-FC

System :	dc power
Component :	Battery Charger
Failure Mode :	High voltage/ amperage output No voltage/amperage output
Start Date :	1997/01/01
Data Version :	2009/12/31

Total Number of Independent Failure Events: 232.70
Total Number of Common-Cause Failure Events: 9

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9694650	0.9875220	0.9897130	0.9980780	0.9898020	1.4103E+02	1.7820E+00
α_2	1.92E-03	1.25E-02	1.03E-02	3.05E-02	1.02E-02	1.7820E+00	1.4103E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9713700	0.9861030	0.9875110	0.9960300	0.9895540	2.2304E+02	3.1433E+00
α_2	2.30E-03	1.05E-02	9.10E-03	2.35E-02	7.89E-03	2.3761E+00	2.2381E+02
α_3	8.14E-05	3.39E-03	2.09E-03	1.12E-02	2.56E-03	7.6722E-01	2.2542E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9752120	0.9872080	0.9882490	0.9956540	0.9919820	3.0405E+02	3.9398E+00
α_2	1.24E-03	6.70E-03	5.66E-03	1.57E-02	3.21E-03	2.0626E+00	3.0593E+02
α_3	4.80E-04	4.56E-03	3.54E-03	1.21E-02	3.85E-03	1.4045E+00	3.0659E+02
α_4	4.45E-06	1.53E-03	6.64E-04	6.01E-03	9.62E-04	4.7267E-01	3.0752E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9763460	0.9866250	0.9873850	0.9943130	0.9934190	4.1850E+02	5.6735E+00
α_2	1.49E-03	6.18E-03	5.42E-03	1.35E-02	1.56E-03	2.6212E+00	4.2155E+02
α_3	7.07E-04	4.37E-03	3.62E-03	1.06E-02	2.71E-03	1.8556E+00	4.2232E+02
α_4	1.21E-04	2.36E-03	1.64E-03	7.05E-03	1.93E-03	9.9939E-01	4.2317E+02
α_5	3.91E-10	4.65E-04	4.66E-05	2.41E-03	3.85E-04	1.9728E-01	4.2398E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9782290	0.9873080	0.9879420	0.9942350	0.9943530	5.0368E+02	6.4749E+00
α_2	1.23E-03	5.13E-03	4.50E-03	1.12E-02	9.66E-04	2.6151E+00	5.0754E+02
α_3	5.28E-04	3.48E-03	2.85E-03	8.56E-03	1.63E-03	1.7745E+00	5.0838E+02
α_4	2.55E-04	2.63E-03	2.02E-03	7.11E-03	1.93E-03	1.3424E+00	5.0881E+02
α_5	1.08E-05	1.17E-03	6.15E-04	4.22E-03	9.64E-04	5.9720E-01	5.0956E+02
α_6	1.46E-12	2.86E-04	1.06E-05	1.58E-03	1.61E-04	1.4574E-01	5.1001E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9898020	0.9895540	0.9919820	0.9934190	0.9943530
α_2	1.02E-02	7.89E-03	3.21E-03	1.56E-03	9.66E-04
α_3		2.56E-03	3.85E-03	2.71E-03	1.63E-03
α_4			9.62E-04	1.93E-03	1.93E-03
α_5				3.85E-04	9.64E-04
α_6					1.61E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.90E-01	9.90E-01	9.92E-01	9.93E-01	9.94E-01
Beta	1.02E-02	1.04E-02	8.02E-03	6.58E-03	5.65E-03
Gamma		2.45E-01	6.00E-01	7.63E-01	8.29E-01
Delta			2.00E-01	4.61E-01	6.52E-01
Epsilon				1.67E-01	3.68E-01
Mu					1.43E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	126.81	190.22	253.62	317.03	380.44
N_1	3.9717	3.2651	4.2972	5.3083	6.2967
N_2	1.3475	1.5424	0.8345	0.5070	0.3759
N_3		0.5000	1.0002	0.8782	0.6327
N_4			0.2500	0.6250	0.7502
N_5				0.1250	0.3750
N_6					0.0625

1.14.2.2 DC POWER BATTERY CHARGER NO OUTPUT SPAR:BCH-LP

System : dc power
Component : Battery Charger
Failure Mode : No voltage/amperage output
Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 200.00
Total Number of Common-Cause Failure Events: 9

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9651390	0.9857430	0.9882380	0.9978060	0.9882120	1.2321E+02	1.7820E+00
α_2	2.20E-03	1.43E-02	1.18E-02	3.49E-02	1.18E-02	1.7820E+00	1.2321E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9675610	0.9842400	0.9858320	0.9954930	0.9879000	1.9631E+02	3.1433E+00
α_2	2.61E-03	1.19E-02	1.03E-02	2.67E-02	9.14E-03	2.3761E+00	1.9708E+02
α_3	9.24E-05	3.85E-03	2.37E-03	1.26E-02	2.96E-03	7.6722E-01	1.9869E+02

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9719850	0.9855340	0.9867090	0.9950800	0.9907080	2.6841E+02	3.9398E+00
α_2	1.40E-03	7.57E-03	6.41E-03	1.77E-02	3.72E-03	2.0626E+00	2.7029E+02
α_3	5.43E-04	5.16E-03	4.01E-03	1.37E-02	4.46E-03	1.4045E+00	2.7095E+02
α_4	5.04E-06	1.74E-03	7.52E-04	6.80E-03	1.11E-03	4.7267E-01	2.7188E+02

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9735880	0.9850550	0.9858970	0.9936420	0.9923720	3.7395E+02	5.6735E+00
α_2	1.67E-03	6.90E-03	6.06E-03	1.50E-02	1.81E-03	2.6212E+00	3.7700E+02
α_3	7.90E-04	4.89E-03	4.05E-03	1.18E-02	3.14E-03	1.8556E+00	3.7777E+02
α_4	1.35E-04	2.63E-03	1.83E-03	7.88E-03	2.23E-03	9.9939E-01	3.7862E+02
α_5	4.37E-10	5.20E-04	5.20E-05	2.69E-03	4.47E-04	1.9728E-01	3.7943E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9756870	0.9858220	0.9865230	0.9935530	0.9934530	4.5022E+02	6.4749E+00
α_2	1.38E-03	5.73E-03	5.02E-03	1.25E-02	1.12E-03	2.6151E+00	4.5408E+02
α_3	5.90E-04	3.89E-03	3.19E-03	9.56E-03	1.89E-03	1.7745E+00	4.5492E+02
α_4	2.85E-04	2.94E-03	2.25E-03	7.94E-03	2.24E-03	1.3424E+00	4.5535E+02
α_5	1.21E-05	1.31E-03	6.87E-04	4.71E-03	1.12E-03	5.9720E-01	4.5610E+02
α_6	1.63E-12	3.19E-04	1.19E-05	1.77E-03	1.86E-04	1.4574E-01	4.5655E+02

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9882120	0.9879000	0.9907080	0.9923720	0.9934530
α_2	1.18E-02	9.14E-03	3.72E-03	1.81E-03	1.12E-03
α_3		2.96E-03	4.46E-03	3.14E-03	1.89E-03
α_4			1.11E-03	2.23E-03	2.24E-03
α_5				4.47E-04	1.12E-03
α_6					1.86E-04

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.88E-01	9.88E-01	9.91E-01	9.92E-01	9.93E-01
Beta	1.18E-02	1.21E-02	9.29E-03	7.63E-03	6.55E-03
Gamma		2.45E-01	6.00E-01	7.63E-01	8.29E-01
Delta			2.00E-01	4.61E-01	6.52E-01
Epsilon				1.67E-01	3.68E-01
Mu					1.43E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	108.99	163.49	217.98	272.48	326.98
N_1	3.9717	3.2651	4.2972	5.3083	6.2967
N_2	1.3475	1.5424	0.8345	0.5070	0.3759
N_3		0.5000	1.0002	0.8782	0.6327
N_4			0.2500	0.6250	0.7502
N_5				0.1250	0.3750
N_6					0.0625

1.14.3DC Power Distribution Circuit Breakers

1.14.3.1 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 : 2009/12/31

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

1.14.3.2 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 : 2009/12/31

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

1.14.3.3 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 : 2009/12/31

Total Number of Independent Failure Events: 13.00
Total Number of Common-Cause Failure Events: 0

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9264700	0.9816510	0.9925140	0.9999640	1.0000000	2.3246E+01	4.3452E-01
α_2	3.34E-05	1.83E-02	7.49E-03	7.35E-02	0.00E+00	4.3452E-01	2.3246E+01

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9278990	0.9747830	0.9816050	0.9983330	1.0000000	4.2555E+01	1.1009E+00
α_2	6.06E-04	1.91E-02	1.24E-02	6.04E-02	0.00E+00	8.3366E-01	4.2822E+01
α_3	2.15E-07	6.12E-03	1.24E-03	2.90E-02	0.00E+00	2.6722E-01	4.3389E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9271180	0.9695840	0.9745680	0.9949930	1.0000000	5.9136E+01	1.8551E+00
α_2	1.67E-03	2.01E-02	1.52E-02	5.56E-02	0.00E+00	1.2281E+00	5.9763E+01
α_3	7.47E-06	6.63E-03	2.46E-03	2.74E-02	0.00E+00	4.0431E-01	6.0587E+01
α_4	1.58E-08	3.65E-03	5.00E-04	1.83E-02	0.00E+00	2.2267E-01	6.0768E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9378120	0.9686040	0.9713360	0.9900430	1.0000000	1.0916E+02	3.5382E+00
α_2	3.61E-03	1.88E-02	1.60E-02	4.34E-02	0.00E+00	2.1142E+00	1.1058E+02
α_3	4.23E-04	8.67E-03	5.99E-03	2.61E-02	0.00E+00	9.7738E-01	1.1172E+02
α_4	2.18E-06	3.32E-03	1.12E-03	1.41E-02	0.00E+00	3.7439E-01	1.1232E+02
α_5	5.29E-21	6.41E-04	3.63E-07	3.71E-03	0.00E+00	7.2277E-02	1.1263E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9399410	0.9681220	0.9704190	0.9884370	1.0000000	1.2994E+02	4.2787E+00
α_2	3.43E-03	1.67E-02	1.43E-02	3.79E-02	0.00E+00	2.2392E+00	1.3198E+02
α_3	5.99E-04	8.51E-03	6.22E-03	2.42E-02	0.00E+00	1.1418E+00	1.3308E+02
α_4	3.95E-05	4.41E-03	2.31E-03	1.59E-02	0.00E+00	5.9222E-01	1.3363E+02
α_5	6.92E-09	1.66E-03	2.24E-04	8.29E-03	0.00E+00	2.2220E-01	1.3400E+02
α_6	1.05E-18	6.20E-04	1.08E-06	3.62E-03	0.00E+00	8.3237E-02	1.3414E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9459110	0.9683280	0.9698500	0.9855410	1.0000000	1.9705E+02	6.4450E+00
α_2	4.27E-03	1.52E-02	1.36E-02	3.14E-02	0.00E+00	3.0878E+00	2.0041E+02
α_3	1.08E-03	8.02E-03	6.47E-03	2.02E-02	0.00E+00	1.6312E+00	2.0186E+02
α_4	2.44E-04	4.86E-03	3.36E-03	1.46E-02	0.00E+00	9.8887E-01	2.0251E+02
α_5	1.26E-05	2.56E-03	1.21E-03	9.69E-03	0.00E+00	5.2177E-01	2.0297E+02
α_6	3.30E-10	9.15E-04	7.82E-05	4.80E-03	0.00E+00	1.8628E-01	2.0331E+02
α_7	0.00E+00	1.43E-04	1.25E-13	5.38E-04	0.00E+00	2.9071E-02	2.0347E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9483960	0.9688070	0.9701040	0.9847820	1.0000000	2.3173E+02	7.4610E+00
α_2	4.21E-03	1.40E-02	1.27E-02	2.83E-02	0.00E+00	3.3447E+00	2.3585E+02
α_3	1.08E-03	7.27E-03	5.95E-03	1.80E-02	0.00E+00	1.7384E+00	2.3745E+02
α_4	3.39E-04	4.79E-03	3.50E-03	1.37E-02	0.00E+00	1.1465E+00	2.3804E+02
α_5	5.39E-05	2.96E-03	1.74E-03	1.00E-02	0.00E+00	7.0833E-01	2.3848E+02
α_6	8.68E-07	1.53E-03	5.02E-04	6.56E-03	0.00E+00	3.6696E-01	2.3882E+02
α_7	6.81E-14	5.14E-04	9.25E-06	2.93E-03	0.00E+00	1.2297E-01	2.3907E+02
α_8	1.28E-42	1.38E-04	1.97E-12	5.85E-04	0.00E+00	3.3124E-02	2.3916E+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	13.00	13.00	13.00	13.00	13.00	13.00	13.00
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

1.15 Reactor Protection System, Reactor Trip Breakers

1.15.1Reactor Trip Breakers

1.15.1.1 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 :	2009/12/31

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

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9081850	0.9677690	0.9763880	0.9978580	1.0000000	3.3055E+01	1.1009E+00
α_2	7.80E-04	2.44E-02	1.59E-02	7.70E-02	0.00E+00	8.3366E-01	3.3322E+01
α_3	2.75E-07	7.82E-03	1.59E-03	3.71E-02	0.00E+00	2.6722E-01	3.3889E+01

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9138980	0.9639730	0.9698110	0.9940510	1.0000000	4.9636E+01	1.8551E+00
α_2	1.98E-03	2.39E-02	1.80E-02	6.57E-02	0.00E+00	1.2281E+00	5.0263E+01
α_3	8.87E-06	7.85E-03	2.92E-03	3.24E-02	0.00E+00	4.0431E-01	5.1087E+01
α_4	1.87E-08	4.32E-03	5.93E-04	2.17E-02	0.00E+00	2.2267E-01	5.1268E+01

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9321610	0.9657140	0.9686860	0.9891110	1.0000000	9.9661E+01	3.5382E+00
α_2	3.95E-03	2.05E-02	1.75E-02	4.73E-02	0.00E+00	2.1142E+00	1.0109E+02
α_3	4.63E-04	9.47E-03	6.55E-03	2.85E-02	0.00E+00	9.7738E-01	1.0222E+02
α_4	2.39E-06	3.63E-03	1.22E-03	1.54E-02	0.00E+00	3.7439E-01	1.0282E+02
α_5	5.78E-21	7.00E-04	3.96E-07	4.06E-03	0.00E+00	7.2277E-02	1.0313E+02

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9354210	0.9656940	0.9681580	0.9875430	1.0000000	1.2044E+02	4.2787E+00
α_2	3.69E-03	1.80E-02	1.54E-02	4.08E-02	0.00E+00	2.2392E+00	1.2248E+02
α_3	6.45E-04	9.16E-03	6.70E-03	2.61E-02	0.00E+00	1.1418E+00	1.2358E+02
α_4	4.25E-05	4.75E-03	2.49E-03	1.71E-02	0.00E+00	5.9222E-01	1.2413E+02
α_5	7.45E-09	1.78E-03	2.42E-04	8.93E-03	0.00E+00	2.2220E-01	1.2450E+02
α_6	1.13E-18	6.67E-04	1.17E-06	3.90E-03	0.00E+00	8.3237E-02	1.2464E+02

CCCG = 7

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9432840	0.9667780	0.9683730	0.9848250	1.0000000	1.8755E+02	6.4450E+00
α_2	4.49E-03	1.59E-02	1.43E-02	3.29E-02	0.00E+00	3.0878E+00	1.9091E+02
α_3	1.13E-03	8.41E-03	6.79E-03	2.12E-02	0.00E+00	1.6312E+00	1.9236E+02
α_4	2.55E-04	5.10E-03	3.53E-03	1.53E-02	0.00E+00	9.8887E-01	1.9301E+02
α_5	1.32E-05	2.69E-03	1.27E-03	1.02E-02	0.00E+00	5.2177E-01	1.9347E+02
α_6	3.47E-10	9.60E-04	8.20E-05	5.04E-03	0.00E+00	1.8628E-01	1.9381E+02
α_7	0.00E+00	1.50E-04	1.31E-13	5.64E-04	0.00E+00	2.9071E-02	1.9397E+02

CCCG = 8

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9462860	0.9675170	0.9688690	0.9841460	1.0000000	2.2223E+02	7.4610E+00
α_2	4.38E-03	1.46E-02	1.32E-02	2.95E-02	0.00E+00	3.3447E+00	2.2635E+02
α_3	1.12E-03	7.57E-03	6.19E-03	1.87E-02	0.00E+00	1.7384E+00	2.2795E+02
α_4	3.53E-04	4.99E-03	3.65E-03	1.42E-02	0.00E+00	1.1465E+00	2.2854E+02
α_5	5.61E-05	3.08E-03	1.81E-03	1.04E-02	0.00E+00	7.0833E-01	2.2898E+02
α_6	9.04E-07	1.60E-03	5.23E-04	6.83E-03	0.00E+00	3.6696E-01	2.2932E+02
α_7	7.09E-14	5.35E-04	9.63E-06	3.05E-03	0.00E+00	1.2297E-01	2.2957E+02
α_8	1.33E-42	1.44E-04	2.06E-12	6.10E-04	0.00E+00	3.3124E-02	2.2966E+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	3.50	3.50	3.50	3.50	3.50	3.50	3.50
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

2 No Data (Prior Only)

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.

2.1 Generic Distributions

2.1.1 Generic Demand CCF Distribution

2.1.1.1 ALL CCF DEMAND BASED EVENTS 1997 TO CURRENT SPAR: CCF-DEM

Failure Mode : Fail to close (reseat) on demand
Fail to open on demand
Fail to start
Fail to Operate (Open/Close)
Fail to stop

Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 2446.50
Total Number of Common-Cause Failure Events: 97

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9634050	0.9726920	0.9730300	0.9808300	0.9728470	9.1215E+02	2.5608E+01
α_2	1.92E-02	2.73E-02	2.70E-02	3.66E-02	2.72E-02	2.5608E+01	9.1215E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9656500	0.9731230	0.9733470	0.9798310	0.9733270	1.3609E+03	3.7587E+01
α_2	1.12E-02	1.63E-02	1.61E-02	2.22E-02	1.61E-02	2.2803E+01	1.3757E+03
α_3	6.51E-03	1.06E-02	1.03E-02	1.54E-02	1.06E-02	1.4784E+01	1.3837E+03

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9663450	0.9728260	0.9729930	0.9787330	0.9731310	1.8052E+03	5.0425E+01
α_2	1.12E-02	1.56E-02	1.54E-02	2.06E-02	1.53E-02	2.8905E+01	1.8267E+03
α_3	3.63E-03	6.33E-03	6.15E-03	9.62E-03	6.27E-03	1.1737E+01	1.8439E+03
α_4	2.84E-03	5.27E-03	5.10E-03	8.31E-03	5.29E-03	9.7833E+00	1.8458E+03

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9696730	0.9751830	0.9753210	0.9802270	0.9756580	2.2837E+03	5.8116E+01
α_2	8.25E-03	1.16E-02	1.15E-02	1.55E-02	1.12E-02	2.7259E+01	2.3146E+03
α_3	4.07E-03	6.55E-03	6.41E-03	9.51E-03	6.40E-03	1.5335E+01	2.3265E+03
α_4	1.75E-03	3.49E-03	3.35E-03	5.70E-03	3.47E-03	8.1629E+00	2.3337E+03
α_5	1.51E-03	3.14E-03	3.00E-03	5.25E-03	3.25E-03	7.3588E+00	2.3345E+03

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9724050	0.9772250	0.9773410	0.9816580	0.9777920	2.7361E+03	6.3768E+01
α_2	6.22E-03	8.93E-03	8.81E-03	1.20E-02	8.50E-03	2.5000E+01	2.7749E+03
α_3	3.92E-03	6.13E-03	6.01E-03	8.74E-03	5.98E-03	1.7153E+01	2.7827E+03
α_4	1.94E-03	3.57E-03	3.45E-03	5.60E-03	3.51E-03	9.9848E+00	2.7899E+03
α_5	7.95E-04	1.93E-03	1.81E-03	3.46E-03	1.93E-03	5.4037E+00	2.7945E+03
α_6	9.88E-04	2.22E-03	2.11E-03	3.86E-03	2.29E-03	6.2261E+00	2.7936E+03

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9728470	0.9733270	0.9731310	0.9756580	0.9777920
α_2	2.72E-02	1.61E-02	1.53E-02	1.12E-02	8.50E-03
α_3		1.06E-02	6.27E-03	6.40E-03	5.98E-03
α_4			5.29E-03	3.47E-03	3.51E-03
α_5				3.25E-03	1.93E-03
α_6					2.29E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.73E-01	9.73E-01	9.73E-01	9.76E-01	9.78E-01
Beta	2.72E-02	2.67E-02	2.69E-02	2.43E-02	2.22E-02
Gamma		3.98E-01	4.30E-01	5.39E-01	6.17E-01
Delta			4.58E-01	5.12E-01	5.64E-01
Epsilon				4.83E-01	5.47E-01
Mu					5.42E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	859.93	1289.89	1719.86	2149.82	2579.79
N_1	41.9722	41.4894	39.2067	37.7493	39.4055
N_2	25.1731	21.9689	27.6768	25.1446	22.7604
N_3		14.5168	11.3326	14.3577	16.0113
N_4			9.5606	7.7885	9.3926
N_5				7.2865	5.1815
N_6					6.1429

2.1.2 Generic Rate CCF Distribution

2.1.2.1 ALL CCF RATE BASED EVENTS 1997 TO CURRENT SPAR: CCF-RATE

Failure Mode : Spurious operation open or close
Fail to run
Filter media allows the pass through of debris
High dP across filter
Fail to control flow
High voltage/ amperage output
Loss of heat transfer capabilities in heat exchangers
No voltage/amperage output
No flow/plugged

Start Date : 1997/01/01
Data Version : 2009/12/31

Total Number of Independent Failure Events: 1857.60
Total Number of Common-Cause Failure Events: 67

ALPHA FACTOR DISTRIBUTIONS

CCCG = 2

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9641020	0.9733720	0.9737170	0.9814740	0.9735380	8.9523E+02	2.4490E+01
α_2	1.85E-02	2.66E-02	2.63E-02	3.59E-02	2.65E-02	2.4490E+01	8.9523E+02

CCCG = 3

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9668950	0.9742880	0.9745210	0.9808970	0.9745220	1.3372E+03	3.5289E+01
α_2	1.00E-02	1.50E-02	1.47E-02	2.07E-02	1.47E-02	2.0532E+01	1.3520E+03
α_3	6.61E-03	1.08E-02	1.05E-02	1.57E-02	1.08E-02	1.4757E+01	1.3577E+03

CCCG = 4

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9702030	0.9763400	0.9765110	0.9818840	0.9767450	1.7802E+03	4.3139E+01
α_2	7.13E-03	1.08E-02	1.06E-02	1.50E-02	1.04E-02	1.9652E+01	1.8037E+03
α_3	5.26E-03	8.45E-03	8.27E-03	1.23E-02	8.45E-03	1.5406E+01	1.8079E+03
α_4	2.22E-03	4.43E-03	4.25E-03	7.26E-03	4.43E-03	8.0813E+00	1.8153E+03

CCCG = 5

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9736030	0.9787670	0.9789070	0.9834530	0.9794110	2.2573E+03	4.8969E+01
α_2	4.92E-03	7.64E-03	7.50E-03	1.08E-02	7.02E-03	1.7615E+01	2.2887E+03
α_3	4.25E-03	6.81E-03	6.66E-03	9.84E-03	6.67E-03	1.5698E+01	2.2906E+03
α_4	2.74E-03	4.85E-03	4.71E-03	7.45E-03	4.90E-03	1.1185E+01	2.2951E+03
α_5	7.14E-04	1.94E-03	1.80E-03	3.65E-03	1.99E-03	4.4708E+00	2.3018E+03

CCCG = 6

Alpha Factor	5th%	Mean	Median	95th%	MLE	a	b
α_1	0.9762820	0.9807670	0.9808860	0.9848620	0.9815060	2.7062E+03	5.3068E+01
α_2	3.50E-03	5.62E-03	5.50E-03	8.15E-03	5.03E-03	1.5513E+01	2.7438E+03
α_3	3.30E-03	5.37E-03	5.25E-03	7.84E-03	5.18E-03	1.4806E+01	2.7445E+03
α_4	2.71E-03	4.61E-03	4.49E-03	6.92E-03	4.60E-03	1.2730E+01	2.7465E+03
α_5	1.24E-03	2.61E-03	2.49E-03	4.39E-03	2.65E-03	7.2117E+00	2.7521E+03
α_6	2.61E-04	1.02E-03	9.00E-04	2.18E-03	1.03E-03	2.8070E+00	2.7565E+03

ALPHA FACTOR and MGL PARAMETERS

Alpha Factor	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
α_1	0.9735380	0.9745220	0.9767450	0.9794110	0.9815060
α_2	2.65E-02	1.47E-02	1.04E-02	7.02E-03	5.03E-03
α_3		1.08E-02	8.45E-03	6.67E-03	5.18E-03
α_4			4.43E-03	4.90E-03	4.60E-03
α_5				1.99E-03	2.65E-03
α_6					1.03E-03

MGL Parameter	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
1-Beta	9.74E-01	9.75E-01	9.77E-01	9.79E-01	9.82E-01
Beta	2.65E-02	2.55E-02	2.33E-02	2.06E-02	1.85E-02
Gamma		4.24E-01	5.54E-01	6.59E-01	7.28E-01
Delta			3.44E-01	5.08E-01	6.15E-01
Epsilon				2.89E-01	4.45E-01
Mu					2.80E-01

Avg. Impact Vector	CCCG=2	CCCG=3	CCCG=4	CCCG=5	CCCG=6
Adj. Ind. Events	856.04	1284.06	1712.07	2140.09	2568.11
N_1	28.9417	23.5646	21.9561	21.0143	21.1847
N_2	24.0553	19.6980	18.4243	15.5003	13.2741
N_3		14.4893	15.0019	14.7205	13.6645
N_4			7.8586	10.8102	12.1379
N_5				4.3985	6.9895
N_6					2.7238

2.1.3 CCF Prior Distribution

2.1.3.1 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.