

SPAR Basic Event Unavailability Data and Results
 2015 Parameter Estimation Update
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Section	Sub Section	Train Unavailability Event	Train Description	Data Source	Analysis	Industry-average Probability Distribution (note a)										Date Range	Comments (see Appendix B for details)	Effective Date
						Data MSPI Trains	Distribution (note b)	5th	Median	Mean	95th	α	β	Error Factor				
Generators	1E EDG	EDG-EPS	Diesel Generator Test And Maintenance	EPIX/RADS	CurveFit/Plant	100	Normal	4.44E-03	1.48E-02	1.48E-02	2.52E-02	0.015	0.0063	1.7	2002-2015		Dec-2016	
	Combustion Turbine	CTG	Combustion Turbine Generator Test or Maintenance	NUREG/CR-6928	JNID/IL	--	Beta	2.12E-04	2.43E-02	5.00E-02	1.87E-01	0.500	9.5000	7.7		Comparison of IPE UAs versus 2002 - 2004 MSPI UAs and 1998 - 2002 ROP SSU UAs indicates a drop of approximately 50% for IPE UAs > 5.0E-3. IPE value divided by 2. IPEs	Jun-2005	
		HPCS	HPCS Diesel Generator Test And Maintenance	EPIX/RADS	CurveFit/Plant	8	Normal	7.59E-03	1.17E-02	1.17E-02	1.58E-02	0.012	0.0025	1.4	2002-2015		Dec-2016	
	Generator Service Water	EDG-SW	Service Water for the Emergency Diesel Generator	EPIX/RADS	CurveFit/Plant	4	Normal	-2.31E-03	9.20E-03	9.17E-03	2.07E-02	0.009	0.0070	2.3	2002-2015		Dec-2016	
		HCS-SW	Service Water for the High Pressure Core Spray Generator	EPIX/RADS	CurveFit/Plant	7	Normal	3.36E-03	5.50E-03	5.54E-03	7.64E-03	0.006	0.0013	1.4	2002-2015		Dec-2016	
Pumps	Motor Driven	MDP-ALL	Motor Driven Pump Test And Maintenance, Clean System	EPIX/RADS	CurveFit/Plant	103	Normal	-1.20E-03	6.20E-03	6.21E-03	1.36E-02	0.006	0.0045	2.2	2002-2015		Dec-2016	
		MDP-AFW	Motor Driven Pump Test And Maintenance, Clean System	EPIX/RADS	CurveFit/Plant	66	Normal	1.75E-04	3.30E-03	3.34E-03	6.43E-03	0.003	0.0019	1.9	2002-2015		Dec-2016	
		MDP-CCW	Motor Driven Pump Test And Maintenance, Clean System	EPIX/RADS	CurveFit/Plant	51	Normal	-1.91E-03	4.50E-03	4.46E-03	1.09E-02	0.005	0.0039	2.4	2002-2015		Dec-2016	
		MDP-ESW	Motor Driven Pump Test And Maintenance, Clean System	EPIX/RADS	CurveFit/Plant	99	Normal	-9.54E-03	9.70E-03	9.66E-03	2.89E-02	0.010	0.0117	3.0	2002-2015		Dec-2016	
		MDP-FWS	Feed Water System Motor-Driven Pumps Total Unavailability	EPIX/RADS	CurveFit/Year	14	Normal	3.53E-04	9.40E-03	9.44E-03	1.84E-02	0.009	0.0055	2.0	2002-2015		Dec-2016	
		MDP-HCS	Motor Driven Pump Test And Maintenance, Clean System	EPIX/RADS	CurveFit/Plant	8	Normal	3.52E-03	7.30E-03	7.35E-03	1.11E-02	0.007	0.0023	1.5	2002-2015		Dec-2016	
		MDP-HPI	Motor Driven Pump Test And Maintenance, Clean System	EPIX/RADS	CurveFit/Plant	69	Normal	1.03E-05	3.30E-03	3.32E-03	6.59E-03	0.003	0.0020	2.0	2002-2015		Dec-2016	
		MDP-RHR	Motor Driven Pump Test And Maintenance, Clean System	EPIX/RADS	CurveFit/Plant	103	Normal	1.25E-03	5.20E-03	5.18E-03	9.15E-03	0.005	0.0024	1.8	2002-2015		Dec-2016	
		MDP-RHR-BWR	Motor Driven Pump Test And Maintenance, Clean System	EPIX/RADS	CurveFit/Plant	34	Normal	2.71E-03	6.00E-03	5.95E-03	9.29E-03	0.006	0.0020	1.5	2002-2015		Dec-2016	
		MDP-RHR-PWR	Motor Driven Pump Test And Maintenance, Clean System	EPIX/RADS	CurveFit/Plant	69	Normal	5.23E-04	4.80E-03	4.81E-03	9.08E-03	0.005	0.0026	1.9	2002-2015		Dec-2016	
		MDP-RHRSW	Motor Driven Pump Test And Maintenance, RHR Service Water	EPIX/RADS	CurveFit/Plant	22	Normal	1.05E-03	4.50E-03	4.55E-03	7.95E-03	0.005	0.0021	1.8	2002-2015		Dec-2016	
		PDP	Positive Displacement Pump Test or Maintenance	NUREG/CR-6928	JNID/IL	--	Beta	1.18E-05	1.37E-03	3.00E-03	1.15E-02	0.500	166.1670	8.4		IPEs	Jun-2005	
		MDP-CLEAN	Motor Driven Pump Test And Maintenance, Clean System	EPIX/RADS	CurveFit/Plant	81	Normal	8.79E-05	4.20E-03	4.22E-03	8.31E-03	0.004	0.0025	2.0	2002-2015		Dec-2016	
		MDP-NR-CLEAN	Motor Driven Pump Test & Maintenance, Normally Running System, Clean	EPIX/RADS	CurveFit/Plant	52	Normal	-1.81E-03	4.60E-03	4.56E-03	1.10E-02	0.005	0.0039	2.4	2002-2015		Dec-2016	
		MDP-NS-CLEAN	Motor Driven Pump Test And Maintenance, Normally Standby System, Clean	EPIX/RADS	CurveFit/Plant	103	Normal	1.31E-03	4.60E-03	4.60E-03	7.89E-03	0.005	0.0020	1.7	2002-2015		Dec-2016	
	MDP-NR-DIRTY	Motor Driven Pump Test And Maintenance, Normally Running System, Dirty	EPIX/RADS	CurveFit/Plant	99	Normal	-9.54E-03	9.70E-03	9.66E-03	2.89E-02	0.010	0.0117	3.0	2002-2015		Dec-2016		
	MDP-NS-DIRTY	Motor Driven Pump Test And Maintenance, Normally Standby System, Dirty	EPIX/RADS	CurveFit/Plant	103	Normal	-9.45E-03	9.30E-03	9.34E-03	2.81E-02	0.009	0.0114	3.0	2002-2015		Dec-2016		
	Turbine Driven	TDP-ALL	Combined UA of TDPs from the AFW, HCI, and RCI systems	EPIX/RADS	CurveFit/Plant	95	Normal	2.92E-04	7.20E-03	7.25E-03	1.41E-02	0.007	0.0042	2.0	2002-2015		Dec-2016	
		TDP-AFW	Turbine Driven Pump Test Or Maintenance (AFW)	EPIX/RADS	CurveFit/Plant	63	Normal	2.65E-04	5.20E-03	5.24E-03	1.01E-02	0.005	0.0030	1.9	2002-2015		Dec-2016	
		TDP-HCI	Turbine Driven Pump Test Or Maintenance (HPCI-RCI)	EPIX/RADS	CurveFit/Plant	24	Normal	7.26E-03	1.17E-02	1.17E-02	1.61E-02	0.012	0.0027	1.4	2002-2015		Dec-2016	
TDP-RCI		Turbine Driven Pump Test Or Maintenance (HPCI-RCI)	EPIX/RADS	CurveFit/Plant	30	Normal	2.83E-03	1.04E-02	1.04E-02	1.80E-02	0.010	0.0046	1.7	2002-2015		Dec-2016		
TDP-HCI-RCI		Turbine Driven Pump Test Or Maintenance (HPCI-RCI)	EPIX/RADS	CurveFit/Plant	24	Normal	7.26E-03	1.17E-02	1.17E-02	1.61E-02	0.012	0.0027	1.4	2002-2015		Dec-2016		
Engine Driven	EDP	Engine Driven Pump Test And Maintenance	EPIX/RADS	CurveFit/Plant	9	Normal	-3.83E-03	1.64E-02	1.64E-02	3.66E-02	0.016	0.0123	2.2	2002-2015		Dec-2016		
	EDP-AFW	Engine Driven Pump Test And Maintenance	EPIX/RADS	CurveFit/Plant	5	Normal	4.10E-03	6.40E-03	6.44E-03	8.70E-03	0.006	0.0014	1.4	2002-2015		Dec-2016		
	EDP-ESW	Engine Driven Pump Test And Maintenance	EPIX/RADS	CurveFit/Plant	4	Normal	2.05E-02	2.89E-02	2.89E-02	3.73E-02	0.029	0.0051	1.3	2002-2015		Dec-2016		
Heat Exchangers	Pooled	HTX	Heat Exchanger In Test Or Maintenance	EPIX/RADS	CurveFit/Plant	37	Normal	-6.26E-03	6.90E-03	6.93E-03	2.01E-02	0.007	0.0080	2.9	2002-2015		Dec-2016	
	CCW	HTX-CCW	Heat Exchanger Test Or Maintenance (CCW)	EPIX/RADS	CurveFit/Plant	34	Normal	-6.19E-03	7.30E-03	7.31E-03	2.08E-02	0.007	0.0082	2.8	2002-2015		Dec-2016	

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							Distribution (note b)	5th	Median	Mean	95th	α	β	Error Factor			
Heat Exch	Service Water	HTX-ESW	Heat Exchanger Test Or Maintenance (ESW)	EPIX/RADS	CurveFit/Year	13	Normal	3.81E-03	1.50E-02	1.50E-02	2.62E-02	0.015	0.0068	1.7	2002-2015		Dec-2016
	Residual Heat Removal	HTX-RHR-BWR	Heat Exchanger And Pump Train Test Or Maintenance (RHR-BWR)	EPIX/RADS	CurveFit/Plant	3	Normal	-3.61E-04	2.60E-03	2.55E-03	5.56E-03	0.003	0.0018	2.1	2002-2015		Dec-2016
		HTX-RHR-PWR	Heat Exchanger And Pump Train Test Or Maintenance (RHR-BWR)	EPIX/RADS	CurveFit/Year	14	Normal	-4.58E-04	2.00E-04	2.42E-04	8.58E-04	0.000	0.0004	4.3	2002-2015		Dec-2016
Electrical	Breaker	CRB	Circuit Breaker Unavailable	Unknown	CurveFit	--	Beta	6.16E-03	5.00E-01	5.00E-01	9.94E-01	0.500	0.5000	2.0			Jun-2005
	Bus	BDC	Bus (DC) Test or Maintenance	IPEs	JNID/IL	--	Beta	7.87E-07	9.10E-05	2.00E-04	7.68E-04	0.500	2499.5000	8.4			IPEs Jun-2005
		BAC	Bus (AC) Test or Maintenance	NUREG/CR-6928	JNID/IL	--	Beta	7.87E-07	9.10E-05	2.00E-04	7.68E-04	0.500	2499.5000	8.4			IPEs Jun-2005
	Battery	BAT	Battery Test or Maintenance	Letter	CurveFit	--	Lognormal	2.80E-06	1.48E-04	2.72E-03	7.84E-03	52.900		52.9			Jun-2005
		BCH	Battery Charger Test or Maintenance	NUREG/CR-6928	JNID/IL	--	Beta	7.89E-06	9.12E-04	2.00E-03	7.68E-03	0.500	249.5000	8.4			IPEs Jun-2005
	Transformer	TFM	Startup Transformer Test or Maintenance	Letter	CurveFit	--	Lognormal	4.55E-07	4.11E-05	1.75E-03	3.72E-03	90.500		90.5			Jun-2005
RPS	CCP-RPS	RPS CH-A IN T&M	NUREG/CR-5500, Vol 2,3,10, and 11	JNID/IL	--	Beta	5.37E-08	8.12E-04	5.00E-03	2.45E-02	0.240	47.7600	30.2			Jun-2005	
Other	Ventilation	ACX	Air Handling Unit Test or Maintenance	NUREG/CR-6928	JNID/IL	--	Beta	9.87E-06	1.14E-03	2.50E-03	9.59E-03	0.500	199.5000	8.4		IPEs	Jun-2005
		CHL	Chiller Test or Maintenance	NUREG/CR-6928	JNID/IL	--	Beta	8.11E-05	9.34E-03	2.00E-02	7.61E-02	0.500	24.5000	8.2		Comparison of IPE UAs versus 2002 - 2004 MSPI UAs and 1998 - 2002 ROP SSU UAs indicates a drop of approximately 50% for IPE UAs > 5.0E-3. IPE value divided by 2. IPEs	Jun-2005
	Compressor	MDC	Motor-Driven Compressor Test or Maintenance	NUREG/CR-6928	JNID/IL	--	Beta	4.80E-05	5.54E-03	1.20E-02	4.59E-02	0.500	41.1667	8.3		Comparison of IPE UAs versus 2002 - 2004 MSPI UAs and 1998 - 2002 ROP SSU UAs indicates a drop of approximately 50% for IPE UAs > 5.0E-3. IPE value divided by 2. IPEs	Jun-2005
		DDC	Diesel Driven Compressor Fails Due To T&M	Existing SPAR	JNID/IL	--	Beta	4.80E-05	5.54E-03	1.20E-02	4.59E-02	0.500	41.1667	8.3		From MDC	Jun-2005
		EDC	Engine-Driven Compressor Test or Maintenance	NUREG/CR-6928	JNID/IL	--	Beta	4.80E-05	5.54E-03	1.20E-02	4.59E-02	0.500	41.1667	8.3		Comparison of IPE UAs versus 2002 - 2004 MSPI UAs and 1998 - 2002 ROP SSU UAs indicates a drop of approximately 50% for IPE UAs > 5.0E-3. IPE value divided by 2. IPEs	Jun-2005
	Fan	FAN	Fan Test or Maintenance	NUREG/CR-6928	JNID/IL	--	Beta	7.89E-06	9.12E-04	2.00E-03	7.68E-03	0.500	249.5000	8.4		IPEs	Jun-2005
		CTF	Cooling Tower Fan Test or Maintenance	NUREG/CR-6928	JNID/IL	--	Beta	7.89E-06	9.12E-04	2.00E-03	7.68E-03	0.500	249.5000	8.4		IPEs	Jun-2005
		Explosive Valve	EPV	Explosive-Operated (SQUIBB) Valve Test or Maintenance	NUREG/CR-6928	JNID/IL	--	Beta	2.36E-06	2.73E-04	6.00E-04	2.30E-03	0.500	832.8330	8.4		IPEs
Headers	Clean Water	HDR-AFW	AFW Header Total Unavailability	EPIX/RADS	CurveFit/Plant	7	Normal	-5.51E-04	6.00E-04	5.61E-04	1.75E-03	0.001	0.0007	2.9	2002-2015		Dec-2016
		HDR-CCW	CCW Header Total Unavailability	EPIX/RADS	CurveFit/Year	14	Normal	-8.51E-04	3.00E-04	3.17E-04	1.45E-03	0.000	0.0007	4.8	2002-2015		Dec-2016
		HDR-HPI	HPI Header Total Unavailability	EPIX/RADS	CurveFit/Plant	8	Normal	-1.29E-04	2.00E-04	2.21E-04	5.29E-04	0.000	0.0002	2.6	2002-2015		Dec-2016
		HDR-ISO	ISO Header Total Unavailability	EPIX/RADS	CurveFit/Plant	4	Normal	1.04E-03	4.00E-03	4.01E-03	6.96E-03	0.004	0.0018	1.7	2002-2015		Dec-2016
		HDR-RHR	RHR Header Total Unavailability	EPIX/RADS	CurveFit/Plant	8	Normal	-1.37E-03	6.00E-04	6.36E-04	2.57E-03	0.001	0.0012	4.3	2002-2015		Dec-2016
		HDR-ESW	ESW Header Total Unavailability	EPIX/RADS	CurveFit/Plant	26	Normal	-3.05E-02	9.00E-03	8.95E-03	4.85E-02	0.009	0.0240	5.4	2002-2015		Dec-2016
	Service Water	HDR-RHRSW	RHRSW Header Total Unavailability	EPIX/RADS	CurveFit/Plant	5	Normal	-4.45E-04	1.20E-03	1.20E-03	2.84E-03	0.001	0.0010	2.4	2002-2015		Dec-2016

Acronyms - AFWS (auxiliary feedwater system), BWR (boiling water reactor), CCW (component cooling water), EPS (emergency power system), ESW (emergency or essential service water), HPCI (high-pressure coolant injection), HPCS (high-pressure core spray), IC (isolation condenser), HTX

Note a - If these distributions are to be used as priors in Bayesian updates using plant-specific data, then a check for consistency between the prior and the data should be performed first, as suggested in supporting requirement DA-D4c in Reference 59 in NUREG/CR-6928 and outlined in Section 6.2.3.5 in Reference 17 in NUREG/CR-6928.
For the ROP UAs, the mean is the average of individual train UAs. Each train UA is the total number of planned and unplanned outage hours divided by total number of plant critical hours.

Note b - For the ROP UAs, the percentiles were obtained from the ordered set of train UAs. The error factor is the 95th percentile divided by the median.

