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MSPI Component Unreliability Baselines

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Outline of Presentation

- Existing MSPI component unreliability (UR) baselines
- Updated SPAR component UR baselines
- Comparison of MSPI vs SPAR baselines
- 2003–mid 2005 EPIX data evaluation
- Impacts of component UR baselines on delta UR calculations

Existing Component UR Baselines

- **Source(s)**
 - **Journal article (RESS, 2003) for most**
 - **EPIX data for 1999–2001**
 - **FTR subdivided into FTR<1H and FTR>1H**
 - **Some component failure modes have limited or no failures**
 - **Hydraulic-operated valve (HOV) FTO/C assumed to be similar to AOV and SOV FTO/C**
 - **Circuit breaker (CBK) FTO/C from separate EPIX data search (1999–2001)**

Updated SPAR UR Baselines

- Upgrade/enhancement to journal article effort
- EPIX data for 1998–2002 (rather than 1999–2001)
 - Newer EPIX database and more components
 - More comprehensive review for potential errors
 - Limit valves to those with <20 demands/yr (generally increases FTO/C)
 - Enhancements in identifying/evaluating FTR<1H vs FTR>1H data (generally reduces FTR>1H)
- To be documented in NUREG/CR report in early 2006

Existing MSPI vs Updated SPAR

Component	Description	Failure Mode (note a)	Failure Probability or Rate			Ratio
			Type	MSPI Mean	SPAR Mean	SPAR/MSPI
AOV	Air-operated valve	FTO/C	Beta	1.0E-03	9.0E-04	0.90
HOV	Hydraulic-operated valve	FTO/C	Beta	1.0E-03	7.0E-04	0.70
MOV	Motor-operated valve	FTO/C	Beta	7.0E-04	1.0E-03	1.43
SOV	Solenoid-operated valve	FTO/C	Beta	1.0E-03	8.0E-04	0.80
DDP Stby	Diesel-driven pump, standby	FTS*	Beta	1.2E-02	6.2E-03	0.52
MDP Stby	Motor-driven pump, standby	FTR>1H	Gamma	2.0E-04	6.0E-05	0.30
		FTS*	Beta	1.9E-03	1.9E-03	1.00
MDP Run/Alt	Motor-driven pump, running or alternating	FTR>1H	Gamma	5.0E-05	5.0E-06	0.10
		FTS*	Beta	1.0E-03	2.0E-03	2.00
TDP Stby, AFW	Turbine-driven pump, standby (AFW)	FTR>1H	Gamma	5.0E-06	5.0E-06	1.00
		FTS*	Beta	9.0E-03	1.1E-02	1.22
TDP Stby, HPCI/RCIC	Turbine-driven pump, standby (HPCI or RCIC)	FTR>1H	Gamma	2.0E-04	6.0E-05	0.30
		FTS*	Beta	1.3E-02	1.1E-02	0.85
EDG Stby	Emergency diesel generator, standby	FTR>1H	Gamma	2.0E-04	6.0E-05	0.30
		FTS	Beta	5.0E-03	5.0E-03	1.00
		FTLR	Beta	3.0E-03	2.5E-03	0.83
CBK	Circuit breaker	FTR>1H	Gamma	8.0E-04	8.0E-04	1.00
		FTO/C	Beta	8.0E-04	1.5E-03	1.88



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Data Comparison – MSPI vs SPAR

Component	Failure Mode (note a)	Existing Baselines			Updated SPAR Baselines		
		Period	Failures	Demands or Hours	Period	Failures	Demands or Hours
AOV	FTO/C	1999 - 2001	22	16100	1998 - 2002	77	82547
HOV	FTO/C				1998 - 2002	8	11942
MOV	FTO/C	1999 - 2001	83	116000	1998 - 2002	239	239297
SOV	FTO/C	1999 - 2001	1	1020	1998 - 2002	24	31028
DDP Stby	FTS	1999 - 2001	2	285	1998 - 2002	11	4398
	FTR<1H	1999 - 2001	0	156	1998 - 2002	3	2940
	FTR>1H	1999 - 2001	No data	No data	1998 - 2002	No data	No data
MDP Stby	FTS	1999 - 2001	56	41700	1998 - 2002	106	89295
	FTR<1H	1999 - 2001	5	5890	1998 - 2002	12	35455
	FTR>1H	1999 - 2001	1	29600	1998 - 2002	2	572574
MDP Run/Alt	FTS	1999 - 2001	89	72400	1998 - 2002	137	89481
	FTR	1999 - 2001	38	7850000	1998 - 2002	86	19793490
TDP Stby, AFW	FTS	1999 - 2001	18	3360	1998 - 2002	45	7352
	FTR<1H	1999 - 2001	11	3630	1998 - 2002	18	6458
	FTR>1H	1999 - 2001	0	2280	1998 - 2002	0	4189
TDP Stby, HPCI/RCIC	FTS	1999 - 2001	20	1410	1998 - 2002	45	7352
	FTR<1H	1999 - 2001	11	3630	1998 - 2002	18	6458
	FTR>1H	1999 - 2001	0	2280	1998 - 2002	0	4189
EDG Stby	FTS	1999 - 2001	59	12700	1998 - 2002	98	23983
	FTLR	1999 - 2001	34	11700	1998 - 2002	58	21105
	FTR>1H	1999 - 2001	28	36300	1998 - 2002	50	61070
CBK	FTO/C	1999 - 2001	?	?	1998 - 2002	91	66179



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Reasons for Differences

- **HOV FTO/C** – more data and more components
- **MOV FTO/C** – limiting data to components with <20 demands/yr
- **DDP FTS*** – adding firewater DDPs (similar UR) and removing one “performance outlier” component to avoid skewing results
- **Most FTR>1H** – enhancement to FTR<1H vs FTR>1H methodology
- **CBK FTO/C** – limiting data to components with <20 demands/yr

2003 – Mid 2005 EPIX Data

- **Comparison of these data (include components outside MSPI scope in most cases) with earlier EPIX data**
 - **Year-by-year comparison (1997 – mid 2005)**
 - **1998 – 2002 comparison (events/yr) with 2003 – mid 2005**
 - **Results generally indicate a significant decrease in failure events/yr for 2003 – mid 2005**
 - **Reasons for this decrease are uncertain at this time**

2003 – Mid 2005 EPIX Data (EDGs)

Standby EDG Data from EPIX								
Years	Events			FTLR Demands		Combined UR (MLE)	Failures/Year	
	FTS	FTLR	CBK FTC	FTR	Total			
1997	29	7	7	18	61	4415	1.38E-02	41.4
1998	23	8	5	8	44	4415	9.97E-03	
1999	21	6	6	6	39	4379	8.91E-03	
2000	22	3	2	12	39	4288	9.10E-03	
2001	21	9	6	7	43	4334	9.92E-03	
2002	10	9	7	16	42	4313	9.74E-03	26.3
2003	11	4	5	11	31	4426	7.00E-03	
2004	14	3	2	9	28	4588	6.10E-03	
2005	4	1	3	2	10	2317	4.32E-03	
Total	155	50	43	89	337	37475	8.99E-03	

Note - The 2005 data include only the first half of the year. For the "Failures/Year" calculation, the 2005 data were doubled to approximate a full year.

2003 – Mid 2005 EPIX Data (MDPs)

Standby and Running/Alternating MDP Data from EPIX

Years	Events			FTS Demands	Combined UR (MLE)	Failures/Year
	FTS	FTR	Total			
1997	65	27	92	60128	1.53E-03	
1998	74	33	107	58785	1.82E-03	
1999	44	21	65	59586	1.09E-03	
2000	61	24	85	59624	1.43E-03	75.8
2001	41	25	66	59399	1.11E-03	
2002	33	23	56	53996	1.04E-03	
2003	38	10	48	52846	9.08E-04	
2004	29	12	41	51642	7.94E-04	36.3
2005	8	2	10	26520	3.77E-04	
Total	393	0 0	177	570	482526	1.18E-03

Note - The 2005 data include only the first half of the year. For the "Failures/Year" calculation, the 2005 data were doubled to approximate a full year.



2003 – Mid 2005 EPIX Data (TDPs)

Standby TDP Data from EPIX

Years	Events			FTS Demands	Combined UR (MLE)	Failures/Year
	FTS	FTR	Total			
1997	15	6	21	1601	1.31E-02	
1998	7	1	8	1627	4.92E-03	
1999	15	3	18	1656	1.09E-02	
2000	17	8	25	1592	1.57E-02	12.8
2001	3	4	7	1496	4.68E-03	
2002	3	3	6	1466	4.09E-03	
2003	4	5	9	1589	5.67E-03	
2004	7	3	10	1573	6.36E-03	9.7
2005	2	3	5	788	6.35E-03	
Total	73	0 0 36	109	13387	8.14E-03	

Note - The 2005 data include only the first half of the year. For the "Failures/Year" calculation, the 2005 data were doubled to approximate a full year.

2003 – Mid 2005 EPIX Data

- **Do not recommend trying to establish component UR baselines from 2003 – mid 2005 data at this time**
 - **Limited data period**
 - **Unexplained decrease in failure events per year**
 - **Actual improvements in component performance?**
 - **Missing or incomplete plant data submittals?**
 - **Other?**

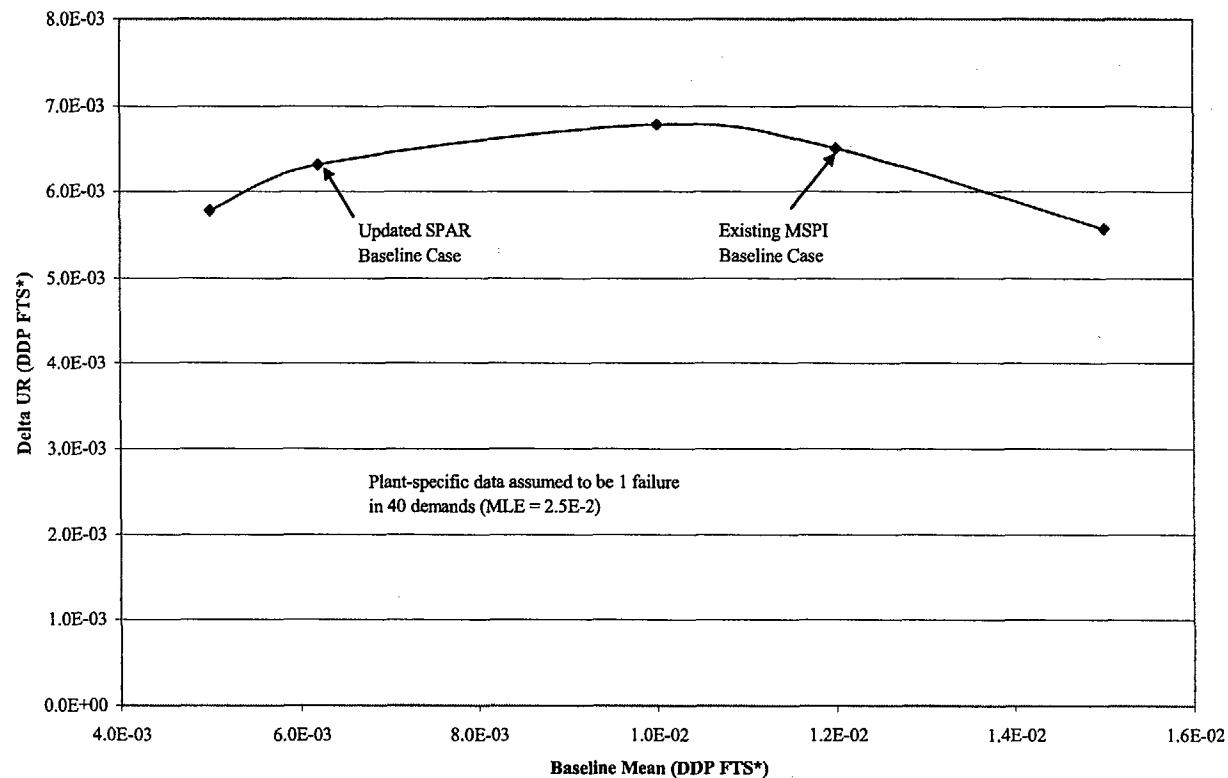


Implications of Changing Baselines

- No simple guidelines or rules of thumb for impacts on delta UR calculations
- Example for DDP FTS*
 - Existing MSPI ($1.2\text{E-}2$) vs updated SPAR ($6.2\text{E-}3$)
 - Lower SPAR baseline results in approximately same delta UR as existing MSPI baseline
 - See following chart for illustration

Implications of Changing Baselines

Delta UR for DDP FTS*



Implications of Changing Baselines

- **Example for Standby MDP FTR>1H**
 - Existing MSPI (5E-5/h) vs updated SPAR (5E-6/h)
 - Lower SPAR baseline results in lower delta UR compared with existing MSPI baseline result
 - See following chart for illustration

Implications of Changing Baselines

Delta UR for Standby MDP FTR>1H

