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## SUMMARY

Data are presented on total loss of offsite power at 38 nuclear power plants. The unavailability of offsite power is  $3.6 \times 10^{-5}$  based on this data. The upper and lower 95% confidence limits on this unavailability are  $1.31 \times 10^{-4}$  and  $8.58 \times 10^{-7}$ , respectively, based on an exponential distribution.

## INTRODUCTION

During the latter part of 1979, the Nuclear Regulatory Commission requested that utilities provide information on loss of offsite power at their nuclear power plants. Responses<sup>(1-28)</sup> to this request which were available by the middle of 1980 were used to obtain a preliminary number for the unavailability of offsite power.

The purpose of this report is to present a summary of the loss of offsite power data and the calculated unavailability of offsite power based on this data. This information is contained in the following two sections.

## LOSS OF OFFSITE POWER DATA

Table I provides a summary of total loss of offsite power events at nuclear power plants. The loss of power date, cause, and duration of the power loss were obtained from References 1 through 28. The number of reactor years for each plant is the difference between the date of criticality for the reactor and the date of the reference that contains the loss of power data. Table I contains data for 38 of the 65 commercially operating light water reactors designed by the current reactor designers. The reactor owners are continuing to supply loss of offsite power data for reactors not included in Table I.

TABLE I. TOTAL LOSS OF OFFSITE POWER EVENTS

Reactor	Loss of Power Date	Cause	Duration	Source/Criticality Dates	Reactor Years
Point Beach 1	2-5-71	Ice storm and improper relay operation	6h 22 min	11-16-79/11-2-70	9.04
	4-27-74	Wire lifted causing breaker failure that isolated 345 KV bus	Unknown		
Point Beach 2	None			11-16-79/5-30-72	7.47
Monticello	None			12-20-79/12-10-70	9.03
Farley 1	9-16-77	Unknown	54 min	12-7-79/8-9-77	2.36
Quad Cities 1	None			12-20-79/10-18-71	8.17
Quad Cities 2	None			12-20-79/4-26-72	7.65
Dresden 1	11-12-65	Tornado	Unknown	12-19-79/10-15-59	20.18
3 Dresden 2	None			12-19-79/1-7-70	9.95
Dresden 3	None			12-19-79/1-31-71	8.88
Salem 1	None			1-3-80/12-11-76	3.06
Beaver Valley	7-28-78	Short circuit in main transformer	17 min	1-2-80/5-10-76	3.65
Brunswick 2	3-26-75	Unknown	4 min	12-18-79/3-20-75	4.75
Nine Mile Point 1	11-17-73	One line failed, other line out for maintenance	10 s	12-21-79/9-5-69	10.29
Pilgrim 1	5-10-77	Snow storm	2h 40 min	12-20-79/6-16-72	7.51
	2-6-78	Snow storm	2h 7 min		
	2-7-78	Snow storm	8h 54 min		
	2-7-78	Snow storm	1h 5 min		

TABLE I. (continued)

Reactor	Loss of Power Date	Cause	Duration	Source/Criticality Dates	Reactor Years
Cook 1	None			1-3-80/1-18-75	4.96
Cook 2	None			1-3-80/3-10-78	1.82
Calvert Cliffs 1	4-13-78	Relay opened breakers	Unknown	1-8-80/10-7-74	5.25
Calvert Cliffs 2	None			1-8-80/11-30-76	3.11
San Onofre 1	6-6-73	Grounding of main generator current transformer leads	4h 59 min	12-26-79/6-14-67	12.53
Oyster Creek	9-8-73	Incorrect setting of current transformer ratio matching taps for differential relay	15 s	1-18-80/5-3-69	10.71
Palisades	9-2-71	Breaker failure to trip on phase to ground fault	56 min	1-31-80/5-24-71	8.69
	9-24-77	Cause of R bus loss unknown	4h 45 min		
	11-25-77	Cause of R bus loss unknown	3h 30 min		
	12-11-77	Cause of R bus loss unknown	1h 30 min		
Indian Point 3	7-13-77	Collapse of distribution system	6h 28 min	1-22-80/4-6-76	3.80
Prairie Island 1	None			1-8-80/12-1-73	6.10
Prairie Island 2	None			1-8-80/12-17-74	5.06
Ginna	10-21-73	High loading causes line to sag and flash to another line	40 min	11-15-79/11-9-69	10.02
	3-4-71	Plant siding fell on bus	30 min		
Crystal River 3	None			11-20-79/1-14-77	2.85
Zion 1	None			6-5-80/6-19-73	6.96
Zion 2	None			6-5-80/12-24-73	6.45
Yankee Rowe	11-9-65	System wide disturbances, "Northeast Blackout"	33 min	3-11-80/8-19-60	19.56
Three Mile Island 1	None			5-30-80/6-5-74	5.98



TABLE I. (continued)

Reactor	Loss of Power Date	Cause	Duration	Source/Criticality Dates	Reactor Years
Arkansas 1	4-7-80	Tornado	22 min	4-24-80/8-6-74	5.72
Arkansas 2	4-7-80	Tornado	22 min	4-24-80/12-5-78	1.38
Peach Bottom 2	None			3-10-80/9-16-73	6.48
Peach Bottom 3	None			3-10-80/8-7-74	5.59
Millstone 2	8-10-76	Salt contamination on insulators	24h 37 min	2-20-80/10-17-75	4.35
Fitzpatrick	10-4-78	Electrician inadvertently placed breaker on line side	14 s	4-8-80/11-17-74	5.39
	3-27-79	Unknown	3 min		
Fort Calhoun 1	3-13-75	Water in junction box actuated fault pressure relay on generator main transformer	Unknown	3-20-80/8-6-73	6.62
	2-21-76	Storm	54 min		
	8-22-77	Faulty relays at offsite substation	0		
Brunswick 1	None			2-8-80/10-8-76	3.34

## LOSS OF OFFSITE POWER ANALYTICAL RESULTS

The 38 reactors listed in Table I experienced 30 total loss of offsite power events during 264.7 reactor years. This results in a loss of offsite power rate,  $\lambda_T$ , of  $1.29 \times 10^{-5}$  events per hour. The  $\lambda_T$  is based on both onsite and offsite events that cause loss of power. The onsite events are due to equipment malfunction and human error and are roughly one third of the total known causes.

The average fault duration time,  $\tau$ , is 2.79 hours based on 26 loss of offsite events for which fault duration data are available.

The unavailability of offsite power,  $\lambda_T \tau$ , is  $3.60 \times 10^{-5}$ . The MOCARS<sup>(29)</sup> Monte Carlo computer code was used to obtain the upper and lower 95% confidence limits of the unavailability. These limits are  $1.31 \times 10^{-4}$  and  $8.58 \times 10^{-7}$  based on an exponential distribution and a sample size of 10,000.

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