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COMPONENT FAILURES at PRESSURIZED WATER REACTORS

FINAL REPORT

Volume II

Prepared by
COMBUSTION ENGINEERING, INC.
Nuclear Power Systems
Windsor, Connecticut 06095

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Printed in the United States of America

Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

Price: Printed Copy \$16.00; Microfiche \$3.00

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M. F. Reisinger
Program Manager

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Prepared for

U. S. Department of Energy
Light Water Reactor Safety Technology Management Center
Sandia National Laboratories
Albuquerque, New Mexico 87185

Sponsored by

U. S. Department of Energy
Division of Nuclear Power Development
Washington, D. C. 20545

Work performed under Sandia Contract No. 13-6442

Printed: October 1980

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ABSTRACT

Combustion Engineering, Inc. conducted a study of system and component failures at all U.S. commercial PWRs which caused reactor scrams and forced outages. The objectives were to identify those systems having major impact on safety and availability (i.e. to identify those systems and components whose failures have historically caused the greatest number of challenges to the reactor protective systems and which have resulted in greatest loss of electric generation time). These problems were identified for engineering solutions and recommendations made for areas and programs where research and development should be concentrated.

The program was conducted in three major phases: Data Analysis, Engineering Evaluation, Cost Benefit Analysis.

The Data Analysis phase analyzed the historical data available to identify and rank the major systems and components leading to challenges to the reactor protective system and lost availability (generation time). The Engineering Evaluation phase 1) reviewed those problems identified in the data analysis to verify or determine "root causes", 2) evaluated the problems for solutions which could reduce or eliminate the problems and 3) recommended R&D programs, where needed, to reduce or eliminate the problems. The Cost Benefit Analysis phase evaluated the savings which would result from the reduction of lost generation time caused by challenges to the protective systems.

This report has been published in two volumes. Volume II consists of Appendices 1 through 4.

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APPENDIX 1A

Glossary of Acronyms and Abbreviations

List of Acronyms

AC	- Alternating Current
ANSI	- American National Standards Institute
B&W	- Babcock and Wilcox Company
BOP	- Balance of Plant
C-E	- Combustion Engineering, Inc.
CEA	- Control Element Assembly
CEDM	- Control Element Drive Mechanism
CEDS	- Control Element Drive System
CEGGS	- Combustion Engineering Generalized Graphics System
CENBAC	- Combustion Engineering Net Benefit Analysis Code
CRS	- Control Rod System
CSW	- Circulating Salt Water
DAS	- Disturbance Analysis System
DC	- Direct Current
EDS	- Electrical Distribution System
EHC	- Electro-Hydraulic Control
EMI	- Electro-Magnetic Interference
EPRI	- Electric Power Research Institute
ESF	- Engineered Safety Feature
FWCS	- Feedwater Control System
LAFC	- Levelized Annual Fixed Charge
LFS	- Limiting Factors Study
LER	- Licensee Event Report
MSIV	- Main Steam Isolation Valve
NRC	- Nuclear Regulatory Commission
NPRDS	- Nuclear Plant Reliability Data System
NSSS	- Nuclear Steam Supply System
O&M	- Operation and Maintenance
PC	- Printed Circuit boards
PWR	- Pressurized Water Reactor
RCP	- Reactor Coolant Pump
RCS	- Reactor Coolant System

List of Acronyms (Continued)

RFI	- Radio Frequency Interference
RPS	- Reactor Protective System
RRS	- Reactor Regulating System
RTD	- Resistance Temperature Detector
SG	- Steam Generator

Terms for Glossary

- Fuel Cost - The generalized term used to evaluate the costs of different fuel types by their heating value, expressed in dollars per million BTU (\$/MBTU).
- GMR - Generation Mix Ratio, the percentage of energy generated by a certain generation type.
- Heat Rate - The amount of heat energy needed to produce a certain amount of electricity, different for each generation type, expressed in BTU/KWhour.
- LAFC Rate - Levelized annual fixed charge rate, the percentage of the borrowed capital that must be paid each year (0.18 in this analysis).
- Net Benefit Curve - A probability density curve showing the likelihood of a benefit over a range of positive and negative values.
- O&M - Operation and Maintenance cost, due to the working of a power plant, expressed in \$/KWhr or mills/KWhr, also called variable costs.
- Variable Cost - See O&M Cost.

APPENDIX 2A

System Descriptions

2A.1 Turbine/Generator System

The Turbine/Generator System, as defined for this study, includes the main turbine, the main generator, the turbine stop and control valves, the electro-hydraulic control system, the moisture separator-reheaters and associated pipes and valves, and the turbine/generator support systems such as the lube oil and the hydrogen cooling systems. This system does not include any secondary cooling water systems, the turbine bypass control valves and control system, the main condenser or anything downstream of the main generator output breakers.

2A.2 Main Steam System

The Main Steam System, as defined for this report, includes the steam generators and supports, the Main Steam Isolation Valves and operators, the secondary safety valves, the atmospheric steam dump valves, the main steam line up to the first set of turbine valves, and all associated piping up to and including the first isolation valve. This system also includes the steam generator level and pressure instrumentation. This system does not include the actuation logic for the Main Steam Isolation Valves.

2A.3 Reactor Coolant Pump System

The reactor coolant pump system, as defined for this report, includes the reactor coolant pumps and motors, the reactor coolant pump lube and lift oil system, the seal injection system from the first isolation valve inside containment, the controlled bleedoff system up to the first isolation valve, all pump instrumentation, and the pump power busses up to and including the RCP power breakers.

2A.4 The Control Rod System

The control rod system, as defined for this report, includes the control rods/control element assemblies, the control rod drive mechanisms and housings, the electronics used for controlled insertion or withdrawal of

the control rods, the Control Rod Drive Mechanism Power Busses up to and including the motor/generator sets, and the control rod drive mechanism cooling system. This system does not include the reactor trip switchgear, the rod position indicating system, or any power busses providing input power to the control electronics power supplies.

2A.5 The Main Feedwater System

The Main Feedwater System, as defined for this report, includes all components, controls and piping associated with supplying normal feedwater flow to the steam generator. This system includes the feedwater isolation valves, feedwater control valves, the main feedwater pumps and support systems, the feedwater control system, the feedwater heaters, the condensate and condensate booster pumps, and the heater drain tanks and pumps. This system does not include the condenser, the steam generator level instrumentation associated with the feedwater control system, the auxiliary feedwater system or any portion of the secondary cooling water systems.

2A.6 The Reactor Coolant System

The reactor coolant system, as defined for this report, includes all main reactor coolant piping, all piping attached to the main reactor coolant piping, up to and including the first isolation valve, the pressurizer, the pressurizer spray valves, the primary safety valves, the quench tank and related piping, and the primary system instrumentation. This system does not include the reactor vessel, the reactor coolant pumps or the steam generators.

2A.7 The Reactor Vessel Internals System

The Reactor Vessel Internals System, as defined for this report, includes all hardware within the reactor vessel that is not directly connected with power production or control. This system includes the core support barrel and flanges, support plates, and reactor vessel specimens and specimen holders. This system does not include the reactor vessel or head, the reactor core or the control element assemblies/control rods.

2A.8 The Reactor Core/Fuel System

The Reactor Core/Fuel System, as defined for this report, consists solely of the fuel bundles and pins, the burnable poison pins and the startup neutron sources.

2A.9 The On-Site Power Systems

The On-Site Power Systems, as defined for this report, includes all cables, busses, primary power supplies, invertors, batteries and transformers providing power to plant systems and components. This system includes the motor control centers for valves and rotating equipment and up to but not including the final power supplies for electronic systems or subsystems. This system does not include the diesel generators and sequencers, the main station transformer, or any equipment associated with the outgoing electrical power.

2A.10 The Condenser System

The Condenser System, as defined for this report, includes the main condenser and water boxes, the equipment used to draw and maintain the condenser vacuum, the condenser instrumentation, and miscellaneous piping and valves associated with the condenser.

2A.11 The Electrical Distribution System

The Electrical Distribution System, as defined for this report, includes the main station transformer, the switchyard, and all breakers and lines downstream of the main generator output breakers. This system is primarily the outgoing power transmission system. It does not include any electrical system providing power to station equipment, and it does not include the transmission lines outside of the switchyard.

2A.12 The Engineered Safety Features System

The Engineered Safety Features System, as defined for this report, includes all pumps, valves, piping, instrumentation, and tanks in the following safety systems; The High Pressure and Low Pressure Safety Injection, The Safety Injection Tanks, Containment Spray, Iodine Removal and Hydrogen Recombiner Systems. This system does not include the actuation logic, the power supplies, the refueling water storage tank or the containment sump.

2A.13 The Chemical and Volume Control System

The Chemical and Volume Control System, as defined for this report, includes the letdown line and all equipment from the isolation valve inside containment, the charging line and equipment up to and including the isolation valves inside containment, the volume control tank, the boric acid batching and makeup systems, the makeup control system, the chemical addition system, and the refueling water tank. This system also includes all support systems piping up to the first isolation valve. This system also includes those portions of the reactor coolant pump seal injection and controlled bleedoff systems that are outside of containment.

2A.14 The Nuclear Instrumentation System

The Nuclear Instrumentation System, as defined for this report, includes the in-core and ex-core detectors, their transmitters, their power supplies and their physical support structures. This system does not include those portions of the Reactor Protection System which use the output of detectors.

2A.15 The Reactor Protection System

The Reactor Protection System, as defined for this report, includes all electronic, electrical and electromechanical components from the Bistable Trip Relays to the output from The Actuation Logic. This system includes The Logic Power Supplies and The Reactor Trip Switch Gear, but does not include any actuated devices in the Engineered Safety Features System. This system also does not include any instrumentation.

2A.16 The Auxiliary Feedwater System

The Auxiliary Feedwater System, as defined for this report, includes The Auxiliary Feedwater pumps, valves, piping and instrumentation, from the condensate storage tank to the junction with the main feedwater system piping. This system also includes the condensate storage tank. This system does not include the actuation logic or the motive power sources for The Auxiliary Feedwater pump.

2A.17 The Circulating and Saltwater System

The Circulating and Saltwater System, as defined for this report, includes the circulating water pumps, the saltwater pumps (as applicable), the intake structures, and all associated piping, valves and instrumentation. This system does not include any components or structures (such as the condenser) where the circulating or saltwater systems interface with other plant systems.

2A.18 The Seismic Restraints System

The Seismic Restraints System, as defined for this report, includes all hydraulic snubbers and pipe hangers for which the actual system to which they belong cannot be identified from the event information, or when the snubbers are treated as a group. This "system" is primarily an event cause classification rather than a true system.

2A.19 The Reactor Vessel System

The Reactor Vessel System, as defined for this report, includes the reactor vessel proper, the vessel head, and the closure studs. This system does not include any internal structures nor any hardware (such as the control rod drive mechanisms) fastened to the vessel head.

2A.20 The Shutdown Cooling System

The Shutdown Cooling System, as defined for this report, includes the shutdown cooling suction line, the shutdown cooling discharge line, the crossover and recirculation lines, and all associated valves, instrumentation and interlocks. This system also includes the shutdown cooling heat exchangers and the shutdown cooling (residual heat removal) pumps if these pumps are not used for safety injection or containment spray. This system does not include any piping, valves or instrumentation that is shared with the safety injection or containment spray systems and whose primary function is associated with the above safety systems.

2A.21 The Emergency Diesel Generator System

The Emergency Diesel Generator System, as defined for this report, includes the diesel engine and support systems, the generator, the air start system, the fuel oil system, and the load sequencer. This system does not include the vital busses.

2A.22 The Non-Nuclear Process Instrumentation System

The Non-Nuclear Process Instrumentation System, as defined for this report, is a general instrument category which includes all process instrumentation such as flow, temperature and pressure detectors for which the proper process system could not be identified based on the information available. If the applicable system was identified then that instrument was included as part of that system.

2A.23 The Containment System

The Containment System, as defined for this report, includes the containment structure, miscellaneous containment penetrations, and the containment sump, the equipment hatch, and the emergency manway.

2A.24 The Blowdown System

The Blowdown System, as defined for this report, includes the steam generator blowdown lines, the blowdown valves, the heat exchangers, filters, tanks and instrumentation.

2A.25 The Containment Isolation System

The Containment Isolation System, as defined for this report, includes all containment isolation valves for which the actual process system cannot be determined based on the available information. This system includes the containment isolation signal and actuated devices (solenoid valves) but does not include the Containment Isolation Actuation Logic.

2A.26 The Compressed Air System

The Compressed Air System, as defined for this report, includes the air compressors, the air dryers, and accumulators, the air lines and all associated instrumentation.

2A.27 The Rod Position Indicating System

The Rod Position Indicating System, as defined for this report, includes the electronic circuits and mechanical devices used to determine the position of the control rods, and the display devices that display these positions to the operator.

2A.28 The Reactor Regulating System

The Reactor Regulating System, as defined for this report, includes the electronic control circuits in which programs for control rod movement and pressurizer pressure and level during normal power operation are generated. This system does not include any actuated devices. These are included in the respective process system.

2A.29 The Boric Acid Injection System

The Boric Acid Injection System, as defined for this report, includes the boric acid injection tanks and valves.

2A.30 The Sampling System

The Sampling System, as defined for this report, includes sample lines, the sampling hold, all instrumentation associated with the sampling system and all valves except the sample line isolation.

2A.31 The Component Cooling Water System

The Component Cooling Water System, as defined for this report, includes the component cooling water pumps, the component cooling water/secondary heat exchangers, the component cooling water pipes and valves, and all associated instrumentation. This system does not include the heat exchangers where the component cooling water systems interfaces with the process systems components. These are assigned to the appropriate process systems.

2A.32 The Cooling Tower System

The Main Cooling Tower System, as defined for this report, includes the Main Condenser cooling towers, the cooling tower transfer pumps and all associated pipes, valves and instrumentation.

2A.33 The Area Monitoring System

The Area Monitoring System, as defined for this report, includes all area radiation monitors, alarms and indicators.

2A.34 The Containment Ventilation System

The Containment Ventilation System, as defined for this report, includes the blowers, dampers, ductwork and instrumentation associated with ventilating the containment area.

2A.35 The Demineralized Water System

The Demineralized Water System, as defined for this report, includes all pumps, valves, piping, instrumentation and ion exchangers needed to provide demineralized water to the other process systems.

2A.36 The Plant Process Computer System

The Plant Process Computer System, as defined for this report, includes only The Plant Process Computer. Input and output parameters (channels) are assigned to their respective process or control systems.

2A.37 The Loose Parts Monitoring System

The Loose Parts Monitoring System, as defined for this report, includes the detectors, the electronic circuits, and annunciators and displays used to detect and annunciate loose parts in the Reactor Coolant System.

2A.38 The Containment Air Purification and Cleanup System

The Containment Air Purification and Cleanup System, as defined for this report, includes the carbon filters, dampers, ductwork and controls used for containment air purification.

2A.39 The Turbine Bypass System

The Turbine Bypass System, as defined for this report, includes the turbine bypass valves and the bypass valve control system.

2A.40 The Communication System

The Communication System, as defined for this report, includes the intercoms, paging system and walkie-talkies used to communicate within a plant.

APPENDIX 2B

Shutdown Data Base Summary Tables and System Problem Profiles

The Problem Profiles Tables of this appendix list the problems and impact of each problem for those systems with an unavailability contribution of greater than 0.1% per plant year.

APPENDIX 2B

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Table 2B-1
PWR CHRONOLOGICAL HISTORY SUMMARY TABLE
 AVAILABILITY STATISTICS BY VENDOR AND YEAR

YEAR	VENDOR											
	BARBOCK AND WILCOX			COMBUSTION ENGINEERING			WESTINGHOUSE			TOTAL PWR		
	SHUTDOWN HOURS	POSSIBLE HOURS	AVAIL	SHUTDOWN HOURS	POSSIBLE HOURS	AVAIL	SHUTDOWN HOURS	POSSIBLE HOURS	AVAIL	SHUTDOWN HOURS	POSSIBLE HOURS	AVAIL
1960	0.0	0.0	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0000
1961	0.0	0.0	0.0000	0.0	0.0	0.0000	473.6	4441.0	.8934	473.6	4441.0	.8934
1962	0.0	0.0	0.0000	0.0	0.0	0.0000	3151.0	8760.0	.6403	3151.0	8760.0	.6403
1963	0.0	0.0	0.0000	0.0	0.0	0.0000	2004.2	8760.0	.7712	2004.2	8760.0	.7712
1964	0.0	0.0	0.0000	0.0	0.0	0.0000	932.9	8784.0	.8938	932.9	8784.0	.8938
1965	0.0	0.0	0.0000	0.0	0.0	0.0000	2336.2	8760.0	.7333	2336.2	8760.0	.7333
1966	0.0	0.0	0.0000	0.0	0.0	0.0000	929.9	8760.0	.8938	929.9	8760.0	.8938
1967	0.0	0.0	0.0000	0.0	0.0	0.0000	313.5	8760.0	.9642	313.5	8760.0	.9642
1968	0.0	0.0	0.0000	0.0	0.0	0.0000	8385.1	26352.0	.6818	8385.1	26352.0	.6818
1969	0.0	0.0	0.0000	0.0	0.0	0.0000	4605.9	26280.0	.8247	4605.9	26280.0	.8247
1970	0.0	0.0	0.0000	0.0	0.0	0.0000	6897.4	30985.0	.7774	6897.4	30985.0	.7774
1971	0.0	0.0	0.0000	24.0	24.0	0.0000	7877.8	51000.0	.8455	7901.8	51024.0	.8451
1972	0.0	0.0	0.0000	3764.8	8880.0	.5760	13406.7	53376.0	.7488	17171.5	62256.0	.7242
1973	1015.1	4081.0	.7535	7048.5	17520.0	.5977	21740.6	88996.0	.7553	29835.2	110597.0	.7302
1974	5002.2	15098.0	.6657	11369.1	22201.0	.4879	43204.5	130610.0	.6692	59575.8	167909.0	.6652
1975	14408.1	50017.0	.7101	8747.5	32137.0	.7278	32417.5	152161.0	.7864	55743.1	234315.0	.7621
1976	22811.5	52704.0	.5670	9535.5	44184.0	.7442	50549.6	172081.0	.7060	82946.7	268969.0	.6916
1977	16070.5	60600.0	.7348	11805.2	59161.0	.8005	44212.6	189145.0	.7663	72088.3	308906.0	.7666
1978	21093.3	70128.0	.7005	15458.5	61320.0	.7251	49513.5	210914.0	.7652	87375.3	342362.0	.7444
TOTAL	80401.7	252628.0	.6817	69153.2	245427.0	.7182	293112.5	1188925.0	.7535	442667.4	1686980.0	.7376

TABLE 2B-2

PLANT SHUTDOWNS
SORTED BY SYSTEM CAUSING SHUTDOWN
DATA FROM 1 161 TO 123178

SHUTDOWN STATISTICS BY SYSTEM AND VENDOR

PAGE 1 OF 10

DATA FROM 1 161 TO 123178

SYSTEM	VENDOR	TOTAL SHDOWNS	POWER REDUCT /HOLD	PLANTS AFFECTD	TOTAL OUTAGE HOURS	OUTAGE DURATION			AVERAGE UNAVAIL	PERIOD HOURS
						MIN.	AVE.	MAX.		
-SYSTEM NAME NOT INDEXED	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	0	0	0	0.0	0.0	0.0	0.0	0.00000	1693388.0
ABB -SYSTEM NAME NOT INDEXED	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	0	0	0	0.0	0.0	0.0	0.0	0.00000	1693388.0
ADMINISTRATIVE SHUTDOWN OR POWER LIMIT	B-W	0	2	1	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	0	2	1	0.0	0.0	0.0	0.0	0.00000	1693388.0
AUXILIARY FEEDWATER SYSTEM	B-W	1	0	1	8.0	8.0	8.0	8.0	.00003	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	5	2	6	1260.3	26.7	252.1	986.4	.00106	1188925.0
	TOT	6	2	7	1268.3	8.0	211.4	986.4	.00075	1693388.0
AREA MONITORING SYSTEM-RADIATION PROTECT	B-W	1	0	1	48.9	48.9	48.9	48.9	.00019	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	1	0	1	48.9	48.9	48.9	48.9	.00003	1693388.0
BORIC ACID INJECTION SYSTEM - WEST.	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	6	2	5	233.0	20.5	38.8	88.4	.00020	1188925.0
	TOT	6	2	5	233.0	20.5	38.8	88.4	.00014	1693388.0

SHUTDOWN STATISTICS BY SYSTEM AND VENDOR

PAGE 2 OF 10

DATA FROM 1 161 TO 123178

SYSTEM	VENDOR	TOTAL SHTDWS	POWER REDUCT /HOLD	PLANTS AFFECTD	TOTAL OUTAGE HOURS	OUTAGE DURATION			AVERAGE UNAVAIL	PERIOD HOURS
						MIN.	AVE.	MAX.		
BLOWDOWN SYSTEM	B-W	1	0	1	7.3	7.3	7.3	7.3	.00003	252628.0
	C-E	2	0	2	210.7	8.3	105.4	202.4	.00084	251835.0
	WST	5	0	3	350.7	11.8	70.1	174.4	.00029	1188925.0
	TOT	8	0	6	568.7	7.3	71.1	202.4	.00034	1693388.0
BPS -SYSTEM NAME NOT INDEXED	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	0	0	0	0.0	0.0	0.0	0.0	0.00000	1693388.0
COMPRESSED AIR SYSTEM	B-W	1	0	1	24.0	24.0	24.0	24.0	.00010	252628.0
	C-E	5	0	3	372.4	5.2	74.5	332.5	.00148	251835.0
	WST	13	0	11	108.8	1.1	8.4	24.5	.00009	1188925.0
	TOT	19	0	15	505.2	1.1	26.6	332.5	.00030	1693388.0
COMPONENT COOLING WATER SYSTEM	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	1	0	1	22.9	22.9	22.9	22.9	.00009	251835.0
	WST	4	0	2	57.6	9.9	14.4	18.4	.00005	1188925.0
	TOT	5	0	3	80.5	9.9	16.1	22.9	.00005	1693388.0
CONDENSER SYSTEM	B-W	7	16	8	660.1	4.0	94.3	384.0	.00261	252628.0
	C-E	13	87	5	4947.9	7.2	380.6	3638.1	.01965	251835.0
	WST	48	151	23	2182.0	-0.0	45.5	254.3	.00184	1188925.0
	TOT	68	254	36	7790.0	-0.0	114.6	3638.1	.00460	1693388.0
CONTAINMENT ISOLATION SYSTEM	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	2	0	2	231.9	7.6	116.0	224.3	.00092	251835.0
	WST	6	0	5	283.1	16.8	47.2	98.0	.00024	1188925.0
	TOT	8	0	7	515.0	7.6	64.4	224.3	.00030	1693388.0

DATA FROM 1 161 TO 123178

SYSTEM	VENDOR	TOTAL SHDWNs	POWER REDUCT /HOLD	PLANTS AFFECTD	TOTAL OUTAGE HOURS	OUTAGE DURATION			AVERAGE UNAVAIL	PERIOD HOURS
						MIN.	AVE.	MAX.		
COMMUNICATION SYSTEM	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	1	0	1	1.2	1.2	1.2	1.2	.00000	1188925.0
	TOT	1	0	1	1.2	1.2	1.2	1.2	.00000	1693388.0
REACTOR CORE - FUEL	B-W	5	47	7	7125.4	62.9	1425.1	4728.7	.02821	252628.0
	C-E	3	1	3	2635.7	19.8	878.6	2513.0	.01047	251835.0
	WST	2	17	13	94.4	1.0	47.2	93.4	.00008	1188925.0
	TOT	10	65	23	9855.5	1.0	965.5	4728.7	.00582	1693388.0
CONTROL ROD SYSTEM, RODS, DRIVES, CONTROLS	B-W	56	15	8	3667.0	0.0	65.5	318.5	.01452	252628.0
	C-E	43	12	6	4049.7	3.7	94.2	507.5	.01608	251835.0
	WST	67	8	18	5301.0	0.0	79.1	4101.0	.00446	1188925.0
	TOT	166	35	32	13017.7	0.0	78.4	4101.0	.00769	1693388.0
CIRCULATING AND SALT WATER SYSTEMS	B-W	1	1	2	144.0	144.0	144.0	144.0	.00057	252628.0
	C-E	7	4	5	432.4	5.1	61.8	225.0	.00172	251835.0
	WST	19	49	14	672.7	-0.0	35.4	271.5	.00057	1188925.0
	TOT	27	54	21	1249.1	-0.0	46.3	271.5	.00074	1693388.0
CONTAINMENT SYSTEM	B-W	2	1	2	368.6	7.3	184.3	361.3	.00146	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	5	1	3	275.3	7.4	55.1	209.4	.00023	1188925.0
	TOT	7	2	5	643.9	7.3	92.0	361.3	.00038	1693388.0
COOLING TOWER SYSTEM	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	1	0	1	10.7	10.7	10.7	10.7	.00004	251835.0
	WST	2	0	1	42.5	18.6	21.3	23.9	.00004	1188925.0
	TOT	3	0	2	53.2	10.7	17.7	23.9	.00003	1693388.0

SHUTDOWN STATISTICS BY SYSTEM AND VENDOR

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DATA FROM 1 161 TO 123178

SYSTEM	VENDOR	TOTAL SHDOWNS	POWER REDUCT /HOLD	PLANTS AFFECTD	TOTAL OUTAGE HOURS	OUTAGE DURATION			AVERAGE UNAVAIL	PERIOD HOURS
						MIN.	AVE.	MAX.		
CHEMICAL AND VOLUME CONTROL SYSTEM	B-W	2	1	3	114.4	10.2	57.2	104.2	.00045	252628.0
	C-E	7	0	4	1382.0	8.1	197.4	1000.3	.00549	251835.0
	WST	15	4	11	893.6	11.0	59.6	168.0	.00075	1188925.0
	TOT	24	5	18	2390.0	8.1	99.6	1000.3	.00141	1693388.0
DEMINERALIZED WATER SYSTEM	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	1	1	1	34.7	34.7	34.7	34.7	.00003	1188925.0
	TOT	1	1	1	34.7	34.7	34.7	34.7	.00002	1693388.0
EMERGENCY DIESEL GENERATORS	B-W	0	1	1	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	2	1	1	741.9	133.9	371.0	608.0	.00295	251835.0
	WST	5	0	3	180.7	13.3	36.1	51.6	.00015	1188925.0
	TOT	7	2	5	922.6	13.3	131.8	608.0	.00054	1693388.0
ELECTRICAL DISTRIBUTION SYSTEM	B-W	7	1	4	123.6	.7	17.7	42.2	.00049	252628.0
	C-E	11	3	5	1059.0	2.9	96.3	281.5	.00421	251835.0
	WST	29	34	17	4663.5	0.0	160.8	3431.2	.00392	1188925.0
	TOT	47	38	26	5846.1	0.0	124.4	3431.2	.00345	1693388.0
END OF CYCLE - COASTDOWN	B-W	0	1	1	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	8	2	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	51	7	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	0	60	10	0.0	0.0	0.0	0.0	0.00000	1693388.0
ENGINEERED SAFETY FEATURES- ECCS	B-W	4	1	4	465.2	24.0	116.3	173.9	.00184	252628.0
	C-E	1	0	1	20.7	20.7	20.7	20.7	.00008	251835.0
	WST	20	8	15	1903.4	2.7	95.2	612.7	.00160	1188925.0
	TOT	25	9	20	2389.3	2.7	95.6	612.7	.00141	1693388.0

DATA FROM 1 161 TO 123178

SYSTEM	VENDOR	TOTAL SHDWS	POWER REDUCT /HOLD	PLANTS AFFECTD	TOTAL OUTAGE HOURS	OUTAGE DURATION			AVERAGE UNAVAIL	PERIOD HOURS
						MIN.	AVE.	MAX.		
MAIN FEEDWATER SYSTEM	B-W	33	49	8	1155.9	0.0	35.0	279.0	.00458	252628.0
	C-E	73	27	7	2033.3	0.0	27.9	754.0	.00807	251835.0
	WST	471	244	25	9454.3	0.0	20.1	1238.0	.00795	1188925.0
	TOT	577	320	40	12643.5	0.0	21.9	1238.0	.00747	1693388.0
HOLD DOWN SYSTEM- SEISMIC RESTRAINTS	B-W	1	0	1	36.8	36.8	36.8	36.8	.00015	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	5	0	4	1035.3	108.3	207.1	304.5	.00087	1188925.0
	TOT	6	0	5	1072.1	36.8	178.7	304.5	.00063	1693388.0
NON-NUCLEAR PROCESS INSTRUMENTATION	B-W	8	0	4	101.6	3.8	12.7	31.2	.00040	252628.0
	C-E	6	1	3	176.9	3.5	29.5	140.6	.00070	251835.0
	WST	37	2	18	503.4	0.0	13.6	112.8	.00042	1188925.0
	TOT	51	3	25	781.9	0.0	15.3	140.6	.00046	1693388.0
LOOSE PARTS MONITORING SYSTEM	B-W	2	0	2	21.1	8.9	10.6	12.2	.00008	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	2	0	2	21.1	8.9	10.6	12.2	.00001	1693388.0
LSF -SYSTEM NAME NOT INDEXED	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	0	0	0	0.0	0.0	0.0	0.0	0.00000	1693388.0
MAINTENANCE	B-W	20	0	8	4407.5	4.6	220.4	1167.2	.01745	252628.0
	C-E	14	0	4	1993.8	18.5	142.4	816.0	.00792	251835.0
	WST	88	3	21	13617.1	0.0	154.7	1408.1	.01145	1188925.0
	TOT	122	3	33	20018.4	0.0	164.1	1408.1	.01182	1693388.0

SHUTDOWN STATISTICS BY SYSTEM AND VENDOR

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DATA FROM 1 161 TO 123178

SYSTEM	VENDOR	TOTAL SHTDOWNS	POWER REDUCT /HOLD	PLANTS AFFECTO	TOTAL OUTAGE HOURS	OUTAGE DURATION			AVERAGE UNAVAIL	PERIOD HOURS
						MIN.	AVE.	MAX.		
MAIN STEAM SYSTEM	B-W	30	3	8	7457.0	3.8	248.6	993.6	.02952	252628.0
	C-E	15	3	6	9228.5	.5	615.2	6589.1	.03665	251835.0
	WST	161	15	22	28400.8	0.0	176.4	2286.5	.02389	1188925.0
	TOT	206	21	36	45086.3	0.0	218.9	6589.1	.02662	1693388.0
NATURAL PHENOMENON	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	1	0	1	16.2	16.2	16.2	16.2	.00006	251835.0
	WST	1	0	1	.3	.3	.3	.3	.00000	1188925.0
	TOT	2	0	2	16.5	.3	8.3	16.2	.00001	1693388.0
NUCLEAR INSTRUMENTATION	B-W	4	2	3	258.2	13.9	64.6	108.4	.00102	252628.0
	C-E	2	0	1	828.3	15.1	414.2	813.2	.00329	251835.0
	WST	33	38	20	385.3	0.0	11.7	149.5	.00032	1188925.0
	TOT	39	40	24	1471.8	0.0	37.7	813.2	.00087	1693388.0
OPERATOR OR TECHNICIAN ERROR	B-W	22	1	7	258.1	.1	11.7	64.6	.00102	252628.0
	C-E	17	0	6	183.7	3.5	10.8	23.3	.00073	251835.0
	WST	151	6	25	1551.7	0.0	10.3	199.6	.00131	1188925.0
	TOT	190	7	38	1993.5	0.0	10.5	199.6	.00118	1693388.0
ON-SITE POWER SYSTEMS	B-W	9	0	5	449.2	.3	49.9	235.9	.00178	252628.0
	C-E	14	0	6	792.0	1.5	56.6	318.5	.00314	251835.0
	WST	116	19	23	7196.9	0.0	62.0	4342.4	.00605	1188925.0
	TOT	139	19	34	8438.1	0.0	60.7	4342.4	.00498	1693388.0
PLANT PROCESS COMPUTER	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	1	0	1	17.8	17.8	17.8	17.8	.00007	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	1	0	1	17.8	17.8	17.8	17.8	.00001	1693388.0

SHUTDOWN STATISTICS BY SYSTEM AND VENDOR

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DATA FROM 1 161 TO 123178

SYSTEM	VENDOR	TOTAL SHTDWS	POWER REDUCT /HOLD	PLANTS AFFECTD	TOTAL OUTAGE HOURS	OUTAGE DURATION			AVERAGE UNAVAIL	PERIOD HOURS
						MIN.	AVE.	MAX.		
REACTOR COOLANT PUMPS	B=W	34	12	8	6413.8	3.3	188.6	671.4	.02539	252628.0
	C=E	22	1	5	1656.8	.7	75.3	389.0	.00658	251835.0
	WST	47	17	18	12593.7	2.3	268.0	2920.0	.01059	1188925.0
	TOT	103	30	31	20664.3	.7	200.6	2920.0	.01220	1693388.0
REACTOR COOLANT SYSTEM	B=W	35	3	8	3792.1	=0.0	108.3	1142.1	.01501	252628.0
	C=E	18	1	6	710.2	3.5	39.5	172.7	.00282	251835.0
	WST	78	22	23	5859.4	=0.0	75.1	841.1	.00493	1188925.0
	TOT	131	26	37	10361.7	=0.0	79.1	1142.1	.00612	1693388.0
REGULATORY REQUIREMENT OR RESTRICTION	B=W	2	2	3	304.9	119.5	152.5	185.4	.00121	252626.0
	C=E	2	1	2	40.6	8.6	20.3	32.0	.00016	251835.0
	WST	63	5	13	5854.2	.2	92.9	5105.5	.00492	1188925.0
	TOT	67	8	18	6199.7	.2	92.5	5105.5	.00366	1693388.0
REFUELING	B=W	17	0	6	23797.2	872.5	1399.8	3427.4	.09420	252628.0
	C=E	15	0	7	28374.0	1032.2	1891.6	3462.8	.11267	251835.0
	WST	80	0	20	119793.2	466.0	1497.4	4634.4	.10076	1188925.0
	TOT	112	0	33	171964.4	466.0	1535.4	4634.4	.10155	1693388.0
ROD POSITION INDICATING SYSTEM	B=W	1	1	2	22.2	22.2	22.2	22.2	.00009	252628.0
	C=E	2	2	3	201.1	37.3	100.6	163.8	.00080	251835.0
	WST	5	17	7	126.9	2.3	25.4	46.3	.00011	1188925.0
	TOT	8	20	12	350.2	2.3	43.8	163.8	.00021	1693388.0
REACTOR PROTECTION SYSTEM	B=W	8	1	4	300.7	2.5	37.6	227.0	.00119	252628.0
	C=E	11	0	6	288.0	5.2	26.2	143.4	.00114	251835.0
	WST	76	1	18	719.7	=0.0	9.5	79.5	.00061	1188925.0
	TOT	95	2	28	1308.4	=0.0	13.8	227.0	.00077	1693388.0

SHUTDOWN STATISTICS BY SYSTEM AND VENDOR

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DATA FROM 1 161 TO 123178

SYSTEM	VENDOR	TOTAL SHDOWNS	POWER REDUCT /HOLD	PLANTS AFFECTD	TOTAL OUTAGE HOURS	OUTAGE DURATION			AVERAGE UNAVAIL	PERIOD HOURS
						MIN.	AVE.	MAX.		
REACTOR REGULATING SYSTEM	B-W	14	4	7	270.8	2.0	19.3	116.4	.00107	252628.0
	C-E	4	0	2	34.4	4.9	8.6	16.0	.00014	251835.0
	WST	6	0	2	40.3	1.3	6.7	16.5	.00003	1188925.0
	TOT	24	4	11	345.5	1.3	14.4	116.4	.00020	1693368.0
REACTOR VESSEL INTERNALS	B-W	5	0	5	9389.6	677.7	1877.9	4539.0	.03717	252628.0
	C-E	1	0	1	907.0	907.0	907.0	907.0	.00360	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	6	0	6	10296.6	677.7	1716.1	4539.0	.00608	1693388.0
REACTOR VESSEL	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	8	0	6	961.6	-0.0	120.2	254.0	.00061	1188925.0
	TOT	8	0	6	961.6	-0.0	120.2	254.0	.00057	1693388.0
SAMPLING SYSTEM	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	2	0	1	188.7	35.9	94.4	152.8	.00016	1188925.0
	TOT	2	0	1	188.7	35.9	94.4	152.8	.00011	1693388.0
CONTAINMENT VENTILATION SYSTEM	B-W	1	0	1	9.2	9.2	9.2	9.2	.00004	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	1	0	1	27.3	27.3	27.3	27.3	.00002	1188925.0
	TOT	2	0	2	36.5	9.2	18.3	27.3	.00002	1693388.0
SECONDARY COMPONENT COOLING WATER SYSTEM	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	1	1	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	0	1	1	0.0	0.0	0.0	0.0	0.00000	1693388.0

SHUTDOWN STATISTICS BY SYSTEM AND VENDOR

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DATA FROM 1 161 TO 123178

SYSTEM	VENDOR	TOTAL SHDOWNS	POWER REDUCT /HOLD	PLANTS AFFECTD	TOTAL OUTAGE HOURS	OUTAGE DURATION			AVERAGE UNAVAIL	PERIOD HOURS
						MIN.	AVE.	MAX.		
CONTAINMENT AIR PURIFICATION AND CLEANUP	B-W	1	0	1	10.6	10.6	10.6	10.6	.00004	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	1	0	1	10.6	10.6	10.6	10.6	.00001	1693388.0
SHUTDOWN COOLING SYSTEM	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	1	0	1	63.8	63.8	63.8	63.8	.00025	251835.0
	WST	7	1	5	867.5	8.4	123.9	712.0	.00073	1188925.0
	TOT	8	1	6	931.3	8.4	116.4	712.0	.00055	1693388.0
TURBINE BYPASS SYSTEM	B-W	1	0	1	6.8	6.8	6.8	6.8	.00003	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1188925.0
	TOT	1	0	1	6.8	6.8	6.8	6.8	.00000	1693388.0
TURBINE GENERATOR SYSTEM	B-W	81	10	9	8032.3	0.0	99.2	5770.4	.03179	252628.0
	C-E	85	12	7	3981.7	.3	46.8	515.0	.01581	251835.0
	WST	414	177	25	51534.1	0.0	124.5	2867.1	.04335	1188925.0
	TOT	580	199	41	63548.1	0.0	109.6	5770.4	.03753	1693388.0
TESTING AND/OR TRAINING	B-W	31	7	7	765.6	.2	24.7	408.0	.00303	252628.0
	C-E	21	11	6	1127.2	3.8	53.7	375.2	.00448	251835.0
	WST	385	205	21	11297.8	0.0	29.3	2478.4	.00950	1188925.0
	TOT	437	223	34	13190.6	0.0	30.2	2478.4	.00779	1693388.0
CAUSE UNKNOWN OR NOT SPECIFIED	B-W	15	0	3	320.1	.7	21.3	73.5	.00127	252628.0
	C-E	1	1	2	6.9	6.9	6.9	6.9	.00003	251835.0
	WST	5	11	9	2120.4	4.6	424.1	2020.6	.00178	1188925.0
	TOT	21	12	14	2447.4	.7	116.5	2020.6	.00145	1693388.0

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DATA FROM 1 161 TO 123178

SYSTEM	VENDOR	TOTAL SHDOWNS	POWER REDUCT /HOLD	PLANTS AFFECTD	TOTAL OUTAGE HOURS	OUTAGE DURATION			AVERAGE UNAVAIL	PERIOD HOURS
						MIN.	AVE.	MAX.		
UNM	-SYSTEM NAME NOT INDEXED									
	B-W	0	0	0	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1168925.0
	TOT	0	0	0	0.0	0.0	0.0	0.0	0.00000	1693388.0
WASTE MANAGEMENT SYSTEM	B-W	0	6	2	0.0	0.0	0.0	0.0	0.00000	252628.0
	C-E	0	0	0	0.0	0.0	0.0	0.0	0.00000	251835.0
	WST	0	0	0	0.0	0.0	0.0	0.0	0.00000	1168925.0
	TOT	0	6	2	0.0	0.0	0.0	0.0	0.00000	1693388.0
EXTERNAL CAUSES	B-W	5	9	5	75.8	6.3	15.2	27.9	.00030	252628.0
	C-E	11	2	5	397.3	3.0	36.1	120.8	.00158	251835.0
	WST	49	96	17	729.2	1.3	14.9	142.0	.00061	1168925.0
	TOT	65	107	27	1202.3	1.3	18.5	142.0	.00071	1693388.0

PRESSURIZED WATER REACTORS
SHUTDOWN HISTORIES
DICTIONARY OF TERMS USED

PLANT NAMES

AN01	ARKANSAS 1 UNIT 1	121974	B	850	BECH	W
AN02	ARKANSAS 1 UNIT 2	32680	C	912	BECH	G
BVS1	BEAVER VALLEY 1	10 176	W	852	S+W	W
BRP1	BIG ROCK POINT 1	32963	G	72	BECH	G
BRF1	BROWNS FERRY 1	8 174	G	1065	UTIL	G
BRF2	BROWNS FERRY 2	3 175	G	1065	UTIL	G
BRF3	BROWNS FERRY 3	3 177	G	1065	UTIL	G
BEP1	BRUNSWICK 1	31877	G	821	UE+C	G
BEP2	BRUNSWICK 2	11 375	G	821	UE+C	G
CCN1	CALVERT CLIFFS 1	5 875	C	845	BECH	G
CCN2	CALVERT CLIFFS 2	4 177	C	845	BECH	W
CPR1	COOPER 1	7 174	G	778	B+R	W
CRP3	CRYSTAL RIVER 3	31377	G	825	GILB	W
DAS1	DAVIS BESSE 1	112177	B	906	BECH	G
DCC1	D C COOK 1	82775	W	1054	AEP	G
DCC2	D C COOK 2	7 178	W	1100	AEP	B
DRS1	DRESDEN 1	7 460	G	200	BECH	G
DRS2	DRESDEN 2	6 972	G	794	S+L	G
DRS3	DRESDEN 3	111671	G	794	S+L	G
DAC1	DUANE ARNOLD 1	2 175	G	538	BECH	G
JMF1	JOSEPH M FARLEY	12 177	W	829	BECH	W
JAF1	FITZPATRICK 1	72875	G	821	S+W	G
FCS1	FORT CALHOUN 1	92673	C	457	G+H	G
REG1	R E GINNA	7 070	W	490	GILB	W
HNP1	HADDAM NECK	1 168	W	575	S+W	W
EIH1	EDWIN HATCH 1	123175	G	786	BECH	G
EIH2	EDWIN HATCH 2	9 579	G	784	BECH	G
HMB1	HUMBOLDT BAY 3	8 063	G	63	BECH	G
IPS2	INDIAN POINT 2	8 073	W	873	UE+C	W
IPS3	INDIAN POINT 3	83076	W	873	UE+C	W
KNP1	KEWAUNEE	6 074	W	535	FPI	W
LBR1	LACROSSE BWR	91369	A	50	S+L	A
HYP1	MAINE YANKEE	122872	C	790	S+W	W
MNS1	MILLSTONE 1	3 071	G	660	EBAS	G
MNS2	MILLSTONE 2	122675	C	830	BECH	G
MNP1	MONTICELLO 1	121070	G	545	BECH	G
NAS1	NORTH ANNA 1	6 678	W	907	S+W	W
NMP1	NINE MILE POINT 1	12 069	G	610	UTIL	G
NEE1	OCONEE 1	71573	B	887	UTIL	G
NEE2	OCONEE 2	9 974	B	887	UTIL	G
NEE3	OCONEE 3	121674	B	887	UTIL	G
OCP1	OYSTER CREEK 1	5 369	G	650	B+R	G
PAL1	PALISADES	123171	C	668	BECH	W
PBS2	PEACH BOTTOM 2	7 574	G	1065	BECH	G
PBS3	PEACH BOTTOM 3	122374	G	1065	BECH	G
PPS1	PILGRIM 1	12 072	G	655	BECH	G
PBH1	POINT BEACH 1	122170	W	497	BECH	W
PBH2	POINT BEACH 2	42073	W	497	BECH	W
PIN1	PRAIRIE ISLAND 1	121673	W	530	FPI	W
PIN2	PRAIRIE ISLAND 2	122174	W	530	FPI	W
QAD1	QUAD CITIES 1	21873	G	789	S+L	G
QAD2	QUAD CITIES 2	31073	G	789	S+L	G
RSS1	RANCHO SECO	41775	B	918	BECH	W
HBR2	H B ROBINSON 2	3 771	W	712	EBAS	W
SOS1	SALEM 1	63077	W	1090	UTIL	W
SLS1	ST LUCIE 1	122176	C	810	EBAS	W
SFS1	SURRY 1	122272	W	822	S+W	W
SFS2	SURRY 2	5 173	W	822	S+W	W
SOS1	SAN ONOFRE 1	1 168	W	430	BECH	W

TM12 THREE MILE ISLAND 2
 TNP1 TROJAN 1
 TPS3 TURKEY POINT 3
 TPS4 TURKEY POINT 4
 VYS1 VERMONT YANKEE 1
 YKR1 YANKEE ROWE
 ZIS1 ZION 1
 ZIS2 ZION 2

123078	D	906	B+K	W
122475	W	1130	BECH	G
121472	W	693	BECH	W
9 773	W	693	BECH	W
112972	G	514	EBAS	G
7 061	W	175	S+W	W
123173	W	1040	S+L	W
91774	W	1040	S+L	W

SHUTDOWN METHODS

AS	NO SHUTDOWN INVOLVED
CO	AUTOMATIC SCRAM
MC	CONTINUATION OF PRIOR OUTAGE
MS	MANUAL CONTROLLED SHUTDOWN
NS	MANUAL SCRAM
PH	GENERATOR OFF-LINE, REACTOR CRITICAL
PI	POWER HOLD BELOW FULL POWER
PR	SPURIOUS OR UNPLANNED POWER INCREASE
	POWER REDUCTION

SYSTEM CODES

ADM	ADMINISTRATIVE SHUTDOWN OR POWER LIMIT
AFS	AUXILIARY FEEDWATER SYSTEM
BAC	AREA MONITORING SYSTEM-RADIATION PROTECT
BAS	BORIC ACID INJECTION SYSTEM - WEST.
BUS	BLOWDOWN SYSTEM
CAS	COMPRESSED AIR SYSTEM
CCW	COMPONENT COOLING WATER SYSTEM
CDS	CONDENSER SYSTEM
CIS	CONTAINMENT ISOLATION SYSTEM
COM	COMMUNICATION SYSTEM
COR	REACTOR CORE - FUEL
CRS	CONTROL ROD SYSTEM, RODS, DRIVES, CONTROLS
CSW	CIRCULATING AND SALT WATER SYSTEMS
CTH	CONTAINMENT SYSTEM
CTS	COOLING TOWER SYSTEM
CVC	CHEMICAL AND VOLUME CONTROL SYSTEM
DMS	DEMINERALIZED WATER SYSTEM
EDG	EMERGENCY DIESEL GENERATORS
EDS	ELECTRICAL DISTRIBUTION SYSTEM
EOC	END OF CYCLE - COASTDOWN
ESF	ENGINEERED SAFETY FEATURES- ECCS
FWS	MAIN FEEDWATER SYSTEM
HUS	HOLD DOWN SYSTEM- SEISMIC RESTRAINTS
INS	NON-NUCLEAR PROCESS INSTRUMENTATION
LPM	LOOSE PARTS MONITORING SYSTEM
MNT	MAINTENANCE
MSS	MAIN STEAM SYSTEM
NAT	NATURAL PHENOMENON
NIS	NUCLEAR INSTRUMENTATION
OPR	OPERATOR OR TECHNICIAN ERROR
OPS	ON-SITE POWER SYSTEMS
PPC	PLANT PROCESS COMPUTER
RCP	REACTOR COOLANT PUMPS
RCS	REACTOR COOLANT SYSTEM
REG	REGULATORY REQUIREMENT OR RESTRICTION
RFL	REFUELING
RPI	ROD POSITION INDICATING SYSTEM
RPS	REACTOR PROTECTION SYSTEM
RRS	REACTOR REGULATING SYSTEM
RVI	REACTOR VESSEL INTERNALS
RVS	REACTOR VESSEL
SAM	SAMPLING SYSTEM
SDD	CONTAINMENT VENTILATION SYSTEM
SCW	SECONDARY COMPONENT COOLING WATER SYSTEM
SCX	CONTAINMENT AIR PURIFICATION AND CLEANUP
SUC	SHUTDOWN COOLING SYSTEM
TBS	TURBINE BYPASS SYSTEM
TGS	TURBINE GENERATOR SYSTEM
TST	TESTING AND/OR TRAINING
UNK	CAUSE UNKNOWN OR NOT SPECIFIED
*MS	WASTE MANAGEMENT SYSTEM
XTN	EXTERNAL CAUSES

Table 2B-3

Problem Profile

for

The Turbine/Generator System
Sheet 1 of 2

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Turbine Blade Failures	1.592%	0.10	1343.3	0.04
Misc. Turbine/Generator Mechanical Problems/Maintenance	0.672%	0.21	276.6	0.06
Turbine Bearing Problems/Maintenance	0.271%	0.06	381.0	0.02
Misc. Turbine Control/Stop Valve Malfunctions or Maintenance	0.21%	0.23	78.7	0.08
Generator Stator Winding Problems	0.171%	0.02	961.4	0.01
Turbine/Generator Inspections and Tests	0.130%	0.23	49.9	0.06
Moisture Separator/Reheater Maintenance	0.113%	0.09	112.0	0.01
EHC Auto-Stop Oil/Fluid System Malfunctions	0.072%	0.30	21.2	0.17
Turbine Piping/Casing Steam Leaks	0.072%	0.15	41.9	0.01
Generator Exciter Malfunctions	0.064%	0.09	60.2	0.05
Generator Hydrogen Cooling System Problems	0.048%	0.06	67.5	0.02
Misc. EHC System Problems	0.041%	0.28	12.7	0.21
Turbine/Generator Balancing	0.039%	0.12	28.3	0.02
Moisture Separator/Reheater Tube Leaks	0.034%	0.07	41.3	0.02
Turbine/Generator Lube Oil System Problems	0.024%	0.05	44.4	0.02

Table 2B-3 (Cont.)

Problem Profile

for

The Turbine/Generator System
Sheet 2 of 2

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
EHC System Electronics Failures	0.018%	0.09	17.0	0.08
Spurious Turbine Control/Stop Valve Closures	0.016%	0.09	15.9	0.07
Turbine/Generator Protection System Malfunctions	0.015%	0.16	8.4	0.13
Turbine/Generator Area Fires	0.014%	0.02	76.2	0.01
Generator Voltage Regulator Failures	0.013%	0.12	9.3	0.11
Generator Breaker/Relay Malfunctions	0.011%	0.09	11.1	0.07
Gland Seal and Extraction Steam System Problems	0.009%	0.03	26.1	0
Moisture Separator/Reheater Valve Problems	0.008%	0.03	25.9	0.01
Turbine/Generator Instrumentation Problems	0.005%	0.04	10.1	0.03
Turbine Control/Stop Valve Position Indicator Failures	0.005%	0.03	13.4	0.02
Moisture Separator/Reheater Level Control Problems	0.004%	0.04	8.0	0.04
Moisture Separator/Reheater Piping Problems/Maintenance	0.004%	0.03	11.5	0.03
EHC Power Supply Malfunctions	0.003%	0.04	6.5	0.03
Spurious Turbine Control/Stop Valve Openings	0.003%	0.03	9.2	0.03
TOTALS	3.760%	3.01	109.5	1.46

Table 2B-4

Problem Profile

for

The Main Steam System

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Steam Generator Tube Leaks	1.734%	0.04	385.3	0.04
Steam Generator Inspection Maintenance or Testing	0.514%	0.10	456.2	0
Misc. MSIV Malfunctions/Maintenance	0.103%	0.14	66.8	0.08
Steam Line Modification/Repair	0.074%	0.02	311.7	0
MSIV Closures, Cause not given	0.060%	0.14	37.6	0.10
Steam Line Drain Line Leaks	0.033%	0.04	78.5	0.01
MSIV Solenoid Valve Failures	0.031%	0.04	73.9	0.04
Steam Leaks at Instrument Taps	0.024%	0.03	68.5	0
Unidentified Steam Leaks	0.017%	0.03	47.4	0.01
Steam Generator Manway Leaks	0.016%	0.02	68.5	0.01
Instrument Valve Leaks	0.015%	0.02	64.2	0
Steam Dump Valve Problems	0.007%	0.02	40.5	0.01
Main Steam Safety Valve Problems	0.006%	0.01	51.0	0.01
MSIV Control Electronics Problems	0.004%	0.04	10.6	0.04
Instrument Failures	0.004%	0.03	14.3	0.02
Misc. Testing	0.001%	0.01	10.5	0
TOTALS	2.667%	1.07	219.5	0.37

Table 2B-5
 Problem Profile
 for
 The Reactor Coolant Pumps

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
RCP Seal Failures/Maintenance	0.628%	0.18	302.8	0.04
RCP Shaft Failure	0.173%	0.01	2920.0	0.01
Unidentified Malfunctions/Repairs	0.129%	0.03	437.9	0.02
RCP Lube Oil System Problems	0.093%	0.14	60.2	0.01
RCP Motor Faults	0.069%	0.02	289.2	0.01
Seal Injection System Problems	0.057%	0.04	119.6	0.02
Excessive RCP Vibration	0.024%	0.02	100.2	0
Controlled Bleedoff System Problems	0.023%	0.02	96.1	0.01
Seal Pressure Sensing Line Leaks	0.009%	0.02	39.8	0
RCP Heat Exchanger Leaks	0.008%	0.01	69.9	0.01
RCP Motor Surge Suppression Capacitor Failures	0.005%	0.02	19.3	0.02
RCP Instrumentation Faults	0.003%	0.01	22.7	0.01
General Testing and Maintenance	0.002%	0.01	20.6	0.01
RCP Seal Vent Line Leaks	0.002%	0.01	28.0	0
TOTALS	1.225%	0.54	200.6	0.17

Table 2B-6

Problem Profile

for

The Control Rod System

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Control Rod Repatch/Changeout	0.269%	0.02	1135.2	0
CRDM Housing Seal Leaks	0.205%	0.11	164.5	0.01
CEA Drops - CRDM Failures	0.089%	0.13	59.8	0.04
CRDM Malfunctions - No Drop	0.043%	0.05	80.2	0.01
CEA Drops - Cause Not Given	0.030%	0.14	18.8	0.09
CEA's Inoperable/Various Causes	0.030%	0.04	73.0	0.01
CEA Drops - Faulty Connections	0.023%	0.04	56.4	0.02
CEA Drops - Various Control Electronics Faults	0.022%	0.13	14.6	0.10
CRDM Cooling System Faults	0.014%	0.03	39.6	0.02
CEA Drops - Power Supply Faults	0.013%	0.07	16.2	0.06
CEA Drops - Power Relay Failures	0.013%	0.03	37.7	0.03
General CEA Testing/Maintenance	0.011%	0.02	47.0	0.02
Motor/Generator System Faults	0.003%	0.02	15.5	0.02
TOTALS	0.772%	0.86	78.4	0.43

Table 2B-7

Problem Profile

for

The Main Feedwater System

Sheet 1 of 2

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Feedwater Control Valves - Misc. Problems/Maintenance	0.119%	0.18	58.8	0.11
Misc. Feedwater System Piping Problems	0.080%	0.05	134.1	0.02
Feedwater Pump Speed Controller Problems	0.079%	0.08	89.4	0.06
Feedwater Control System Problems	0.069%	0.17	35.5	0.17
Feedwater Pump Trips - Cause Not Specified	0.064%	0.26	21.6	0.24
Level Trips - Power Level Not Given	0.055%	0.61	7.9	0.61
Misc. Feedwater System Problems or Maintenance	0.045%	0.06	63.6	0.04
Feedwater Heater Leaks	0.040%	0.10	35.6	0.01
Level Trips During Startup	0.026%	0.55	4.2	0.55
Feedwater System Check Valve Problems	0.023%	0.03	75.0	0
Heater Drain Tank System Problems	0.020%	0.09	18.7	0.06
Feedwater Control Valves - Valve Operator Malfunctions	0.019%	0.15	11.1	0.15
Misc. Feedwater Pump Problems or Maintenance	0.016%	0.06	22.0	0.05
Feedwater Control Valve Bypass Valve Problems	0.016%	0.05	27.7	0.03
Feedwater Control Valves - Valve Malfunctions/Maintenance	0.015%	0.07	18.5	0.04

Table 2B-7 (Cont.)

Problem Profile

for

The Main Feedwater System
Sheet 2 of 2

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Heater Drain Tank Pump Problems	0.014%	0.06	19.7	0.05
Feedwater Pump Piping/Instrumentation Problems	0.013%	0.05	21.2	0.04
Condensate/Condensate Booster Pump Problem	0.008%	0.05	13.3	0.05
Feedwater Pump Mechanical Problems	0.008%	0.03	28.6	0.02
Misc. Feedwater System Valve Problems	0.007%	0.06	11.0	0.01
Feedwater System Instrumentation Problems	0.006%	0.07	6.7	0.05
Feedwater Pump Lube Oil System Problems	0.006%	0.04	12.1	0.04
Feedwater System Pump Suction Strainer Problems	0.003%	0.03	11.6	0.02
Feedwater Isolation Valve Problems	0.003%	0.02	13.2	0.02
Feedwater Pump Packing/Seal Problems	0.002%	0.01	29.2	0
TOTALS	0.761%	2.99	22.4	2.46

Table 2B-8

Problem Profile

for

The Reactor Coolant System

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Pressurizer Safety/Relief Valve Leakage or Maintenance	0.162%	0.07	195.3	0
Leakage From Misc. RCS Valves	0.130%	0.15	78.5	0.01
Pressurizer Spray Valve Problems	0.110%	0.17	56.0	0.03
Misc. Maintenance and Testing	0.041%	0.03	138.3	0.01
Pressurizer Manway Gasket Leaks	0.040%	0.05	74.8	0.01
Loop Isolation Valve Problems	0.040%	0.03	168.5	0.02
Blow Rupture Disc on Quench Tank	0.021%	0.01	179.2	0
Unidentified RCS Leakage	0.018%	0.06	27.6	0
Misc. Instrumentation Faults	0.017%	0.06	25.4	0.04
Instrumentation Valve Leakage	0.016%	0.02	68.1	0
RTD Failures	0.007%	0.01	114.3	0.01
Return Isolated Loop to Service	0.003%	0.02	15.0	0
TOTALS	0.614%	0.68	79.1	0.13

Table 2B-9

Problem Profile

for

Reactor Vessel Internals

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Reactor Vessel Specimen Holder Tube Failure	0.557%	0.03	1877.9	0
Core Support Barrel Flange Wear	0.054%	0.01	907.0	0
TOTALS	0.610%	0.03	1716.1	0

Table 2B-10

Problem Profile

for

Reactor Core/Fuel

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Burnable Poison Pins Damaged	0.408%	0.01	3442.4	0.01
Fuel Inspection for Densification	0.149%	0.01	2513.0	0
Core Physics Tests	0.027%	0.04	57.2	0.01
TOTALS	0.584%	0.05	985.5	0.02

Table 2B-11

Problem Profile

for

The On-Site Power Systems

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Cable Fires	0.274%	0.01	2313.9	0.01
Non-Vital/Instrument Bus Faults	0.091%	0.17	47.7	0.14
General Testing and Maintenance	0.041%	0.02	173.5	0
Circuit Breaker/Switch Faults	0.029%	0.10	25.5	0.09
Non-Vital Bus Inverter/Power Supply Failures	0.017%	0.10	14.4	0.10
Vital Bus Inverter/Power Supply Failures	0.016%	0.11	12.0	0.11
Voltage/Frequency Fluctuations On Busses	0.012%	0.09	11.6	0.08
Transformer Faults	0.012%	0.03	39.4	0.02
Vital Bus Faults	0.006%	0.05	11.9	0.05
Battery System Faults	0.002%	0.02	6.4	0.02
Motor Control Center Faults	0.001%	0.01	9.2	0.01
TOTALS	0.500%	0.72	60.7	0.63

Table 2B-12
Problem Profile
for
The Condenser System

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Condenser Tube Leaks	0.385%	0.18	191.2	0.02
Misc. Condenser Piping Problems	0.017%	0.01	145.7	0
Loss of Condenser Vacuum (Misc. Causes)	0.015%	0.06	23.3	0.03
Condenser Tests and Unidentified Maintenance	0.009%	0.03	31.3	0.01
Condenser Cleaning/Backwashing	0.004%	0.01	35.7	0
Air Ejector System Problems	0.001%	0.01	6.9	0.01
Hotwell Pump Problems	<0.001%	0.01	1.2	0.01
Vacuum Pump Problems	<0.001%	0.01	0.1	0.01
TOTALS	0.439%	0.35	110.5	0.09

Table 2B-13

Problem Profile

for

The Electrical Distribution System

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Main Transformer Failure/Maintenance	0.268%	0.07	347.7	0.03
Switchyard Relay/Breaker Faults	0.052%	0.06	72.6	0.05
Tie-in Temporary/Permanent Main Transformer	0.008%	0.03	27.3	0
Stepup Transformer Faults	0.005%	0.01	38.3	0.01
Misc. Switchyard/Transmission Line Maintenance or Faults	0.004%	0.01	25.0	0.01
Main Transformer Relay Faults	0.003%	0.02	14.9	0.02
Main Transformer Lightning Arrestor Malfunctions	0.003%	0.01	22.7	0.01
Main Transformer Cooling System Faults	0.001%	0.01	10.7	0.01
TOTALS	0.347%	0.24	124.4	0.14

Table 2B-14

Problem Profile

for

The Engineered Safety Features System

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Safety Injection Pump Malfunction	0.040%	0.01	338.9	0
Misc. Safety Injection System Valve Problems	0.032%	0.03	89.8	0
Safety Injection System Pipe Leaks	0.032%	0.01	511.0	0
Safety Injection Tank Check Valve Leaks	0.019%	0.03	63.1	0
Replacement of Unqualified ESF Electrical Terminal Blocks	0.013%	0.01	106.2	0
Malfunction of ESF Actuating Device (Relay, Solenoid, Breaker)	0.004%	0.03	14.1	0.03
Safety Injection Tank Nitrogen Supply Leaks	0.002%	0.01	20.1	0
ESF Safeguards Tests	0.001%	0.01	11.6	0
Safety Injection System Heat Tracing Malfunction (1 Power Reduction)	0%	-	-	0
TOTALS	0.142%	0.14	95.6	0.03

Table 2B-15

Problem Profile

for

The Chemical and Volume Control System

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
CVCS Piping Modification	0.059%	0.01	1000.3	0
Repair of Misc. CVCS Valves	0.024%	0.03	79.7	0.01
Letdown Valve Packing Leaks	0.018%	0.03	50.2	0.01
Charging Pump Filter Weld Leaks	0.012%	0.02	49.9	0
Regenerative Heat Exchanger Leaks	0.010%	0.01	166.1	0.01
CVCS Piping Leaks	0.007%	0.01	109.8	0.01
Charging Line Check Valve Repair	0.005%	0.01	79.0	0.01
Letdown Temperature Control Valve Malfunction	0.005%	0.01	77.4	0
CVCS Relief Valve Leaks	0.001%	0.01	22.0	0.01
Auxiliary Pressurizer Spray Valve Malfunction	0.001%	0.01	11.0	0.01
Volume Control Tank Boron Concentration Anomalies	<0.001%	0.01	8.1	0.01
TOTALS	0.142%	0.12	99.6	0.04

Table 2B-16
 Problem Profile
 for
 The Reactor Protection System

<u>Problem</u>	<u>Average Annual Unavailability Contribution</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Scrams Per Plant Year</u>
Electronic Module/Component Failure	0.017%	0.05	28.7	0.05
Testing Problems	0.012%	0.05	22.5	0.04
Spurious Signal - Cause Unknown	0.010%	0.08	11.1	0.07
Loss of Power Source	0.010%	0.01	80.9	0.01
Spurious Signal with One Channel in Test	0.009%	0.09	9.8	0.09
Spurious Signal - Noise	0.007%	0.03	18.7	0.03
Trip Breaker Problems	0.006%	0.05	11.5	0.05
Relay Malfunctions (Spurious Operation)	0.004%	0.07	5.1	0.07
Setpoint Errors	0.003%	0.02	12.0	0.02
Short Circuits/Grounds	0.002%	0.03	7.6	0.03
Spurious Signals with One Channel in Maintenance	0.001%	0.01	6.4	0.01
Bistable Failures	<0.001%	<0.01	3.3	<0.01
Personal Error During Test or Maintenance	<0.001%	<0.01	1.9	<0.01
TOTALS	0.078%	0.49	13.8	0.47

APPENDIX 2C

Calendar Year

Data Tables

Information contained within this appendix provides the compiled data for calendar year PWR availability contributions discussed in Section 2.4 of this report.

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Table 2C-1

PWR Plant Calendar Year Availability Summary

<u>Calendar Year</u>	<u>Average Plant Availability</u>	<u>Average Plant Unavailability</u>
1968	68.19%	31.81%
1969	82.47%	17.53%
1970	77.74%	22.26%
1971	84.51%	15.49%
1972	72.42%	27.58%
1973	73.25%	26.75%
1974	66.06%	33.94%
1975	78.70%	21.30%
1976	69.14%	30.86%
1977	77.19%	22.81%
1978	74.43%	25.57%

Table 2C-2

PWR Unavailability Contributions Summary

For 1968

<u>Contributor</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	26.37%	12.4	187.8
Refueling	3.52%	0.3	928.0
Regulatory/Administrative	-	-	-
Personnel Error	-	-	-
External Causes	-	-	-
Other	1.92%	1.3	126.8
Totals	31.81%	14.0	199.6

Table 2C-3

PWR Unavailability Contributions Summary

For 1969

<u>Contributor</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	9.62%	9.0	93.6
Refueling	4.91%	0.3	1290.5
Regulatory/Administrative	0.24%	1.0	21.0
Personnel Error	-	-	-
External Causes	0.03%	0.3	7.1
Other	2.74%	0.9	359.4
Totals	17.53%	11.3	135.5

Table 2C-4

PWR Unavailability Contributions Summary

For 1970

<u>Contributor</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	9.00%	10.8	73.4
Refueling	11.65%	0.8	1202.8
Regulatory/Administrative	0.19%	0.8	19.8
Personnel Error	-	-	-
External Causes	0.01%	0.6	1.0
Other	1.42%	3.0	373. 5
Totals	22.26%	13.8	140.8

Table 2C-5

PWR Unavailability Contributions Summary

For 1971

<u>Contributor</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	5.81%	11.3	44.9
Refueling	4.96%	0.5	844.2
Regulatory/Administrative	0.41%	10.5	3.4
Personnel Error	0.02%	1.2	1.5
External Causes	0.18%	0.7	22.9
Other	4.10%	3.3	110.1
Totals	15.49%	27.5	49.4

Table 2C-6

PWR Unavailability Contributions Summary

For 1972

<u>Contributor</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	16.16%	17.1	83.2
Refueling	10.78%	0.7	1342.6
Regulatory/Administrative	0.08%	3.0	2.4
Personnel Error	0.04%	1.6	2.3
External Causes	0.01%	1.1	3.8
Other	0.50%	0.4	104.5
Totals	27.58%	23.8	105.4

Table 2C-7

PWR Unavailability Contributions Summary

For 1973

<u>Contributor</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	17.97%	14.2	111.1
Refueling	6.30%	0.4	1393.2
Regulatory/Administrative	0.14%	9.7	1.3
Personnel Error	0.03%	1.1	2.5
External Causes	0.19%	0.7	23.7
Other	2.12%	1.5	123.4
Totals	26.75%	27.6	84.8

Table 2C-8

PWR Unavailability Contributions Summary

For 1974

<u>Contributor</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	22.94%	13.6	147.6
Refueling	7.00%	0.4	1460.4
Regulatory/Administrative	0.07%	0.8	8.0
Personnel Error	0.03%	1.4	17.7
External Causes	0.04%	0.3	10.9
Other	3.56%	2.8	110.8
Totals	33.94%	19.4	153.6

Table 2C-9

PWR Unavailability Contributions Summary

For 1975

<u>Contributor</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	11.55%	15.1	67.2
Refueling	8.42%	0.6	1315.0
Regulatory/Administrative	0.03%	0.2	12.5
Personnel Error	0.16%	1.2	12.1
External Causes	0.04%	0.4	9.5
Other	1.10%	1.0	96.3
Totals	21.30%	18.5	101.7

Table 2C-10

PWR Unavailability Contributions Summary

For 1976

<u>Contributor</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	15.78%	13.0	106.9
Refueling	12.68%	0.7	1482.3
Regulatory/Administrative	0.20%	0.2	78.8
Personnel Error	0.10%	0.9	9.4
External Causes	0.10%	0.3	27.7
Other	2.00%	1.3	136.3
Totals	30.86%	16.4	165.1

Table 2C-11

PWR Unavailability Contributions Summary

For 1977

<u>Contributor</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	10.80%	13.5	71.6
Refueling	10.80%	0.7	1329.7
Regulatory/Administrative	0.17%	0.1	172.8
Personnel Error	0.11%	0.8	12.1
External Causes	0.10%	0.4	18.7
Other	0.83%	1.1	67.9
Totals	22.81%	16.6	122.2

Table 2C-12

PWR Unavailability Contributions Summary

For 1978

<u>Contributor</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	10.85%	11.4	83.8
Refueling	12.22%	0.8	1349.5
Regulatory/Administrative	1.61%	0.2	918.2
Personnel Error	0.14%	0.9	13.6
External Causes	0.06%	0.2	27.3
Other	0.69%	0.4	132.2
Totals	25.57%	13.8	162.3

Table 2C-13

PWR Unavailability Contributions

For 1968

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
On-Site Power Systems	17.618%	1.3	1160.7
Turbine/Generator System	5.390%	3.3	142.0
Control Rod System	0.835%	1.7	44.0
Reactor Coolant Pumps	0.738%	0.7	97.2
Reactor Coolant System	0.641%	0.7	84.5
Chemical and Volume Control System	0.638%	0.3	168.0
Reactor Protection System	0.340%	1.7	17.9
Main Feedwater System	0.124%	0.7	16.4
Non-Nuclear Process Instrumentation	0.024%	0.7	3.1
Nuclear Instrumentation	0.017%	0.7	2.2
Compressed Air System	0.007%	0.3	1.8
TOTALS	26.37 %	14.0	199.6

Table 2C-14

PWR Unavailability Contributions

For 1969

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine/Generator System	5.624%	3.67	134.4
Reactor Coolant System	1.935%	1.00	169.5
Circulating and Saltwater System	0.626%	0.33	164.5
Control Rod System	0.521%	1.00	45.7
Main Feedwater System	0.404%	1.00	35.4
Reactor Coolant Pumps	0.219%	0.33	57.6
Non-Nuclear Process Instrumentation	0.212%	0.33	55.8
On-Site Power System	0.037%	0.67	4.8
Nuclear Instrumentation	0.023%	0.33	6.1
Electrical Distribution System	0.013%	0.33	3.3
TOTALS	9.62 %	9.0	93.6

Table 2C-15

PWR Unavailability Contributions

For 1970

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Main Feedwater System	2.163%	1.98	95.7
Main Steam System	1.606%	0.85	165.9
Turbine/Generator System	1.252%	1.98	55.4
Reactor Coolant System	0.820%	2.26	31.8
Electrical Distribution System	0.229%	0.28	71.0
Engineered Safety Features System	0.048%	0.28	14.9
Non-Nuclear Process Instrumentation	0.040	0.85	4.1
Reactor Protection System	0.021%	0.28	6.4
Control Rod System	0.010%	0.28	3.2
Condenser System	<0.001%	0.28	<0.1
TOTALS	9.00 %	11.3	44.9

Table 2C-16
PWR Unavailability Contributions
For 1971

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine/Generator System	4.527%	2.40	165.0
On-Site Power Systems	2.268%	1.03	192.9
Main Steam System	0.378%	1.03	32.2
Main Feedwater System	0.185%	2.06	7.9
Reactor Coolant System	0.147%	0.52	25.1
Chemical and Volume Control System	0.121%	0.17	61.6
Electrical Distribution System	0.063%	0.17	32.0
Shutdown Cooling System	0.052%	0.17	26.7
Containment Isolation System	0.039%	0.17	19.8
Condenser System	0.034%	0.17	17.2
Reactor Protection System	0.032%	0.69	4.0
Control Rod System	0.030%	0.69	3.8
Circulating and Saltwater System	0.015%	0.34	3.9
TOTALS	5.81 %	11.3	44.9

Table 2C-17

PWR Unavailability Contributions

For 1972

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine Generator System	4.881%	3.24	132.1
Control Rod System	4.735%	1.69	245.7
Main Steam System	1.854%	1.13	144.3
Chemical and Volume Control System	1.607%	0.14	1000.3
Main Feedwater System	1.526%	3.52	38.0
Electrical Distribution System	0.460%	0.28	143.3
Reactor Coolant System	0.360%	0.99	32.1
On-Site Power Systems	0.223%	0.99	19.8
Nuclear Instrumentation	0.051%	0.42	10.5
Auxiliary Feedwater System	0.043%	0.14	26.7
Non-Nuclear Process Instruments	0.035%	0.28	10.8
Reactor Protection System	0.031%	0.28	8.5
Condenser System	0.017%	0.14	10.3
Rod Position Indicating System	0.004%	0.14	2.3
TOTALS	16.16 %	17.1	83.2

Table 2C-18

PWR Unavailability Contributions

For 1973

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine Generator System	6.861%	4.28	140.5
Main Steam System	4.251%	1.59	235.1
Control Rod System	2.312%	0.63	319.6
Reactor Coolant Pumps	1.132%	0.16	625.8
Reactor Vessel Internals	0.820%	0.08	907.0
Main Feedwater System	0.785%	2.38	28.9
Seismic Restraints	0.721%	0.28	266.0
Reactor Coolant System	0.333%	0.40	73.6
Chemical and Volume Control	0.221%	0.32	61.1
On-Site Power Systems	0.216%	1.51	12.6
Electrical Distribution System	0.125%	0.32	34.6
Auxiliary Feedwater System	0.100%	0.08	111.0
Reactor Protection System	0.067%	0.40	14.9
Condenser System	0.040%	0.24	14.6
Containment Isolation System	0.035%	0.08	39.0
Engineered Safety Features	0.017%	0.24	6.1
Shutdown Cooling System	0.008%	0.08	8.4
Circulating Water System	0.003%	0.08	3.0
Containment System	0.003%	0.16	1.5

Table 2C-18 (Cont'd.)

PWR Unavailability Contributions

For 1973

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Nuclear Instrumentation	0.003%	0.08	3.5
Non-Nuclear Instrumentation	0.002%	0.08	2.0
Communication System	0.001%	0.08	1.2
TOTALS	17.97 %	14.2	111.1

Table 2C-19
PWR Unavailability Contributions
For 1974

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine Generator System	8.766%	2.30	334.5
Main Steam System	5.936%	1.41	369.2
Main Feedwater System	1.790%	4.02	39.0
Reactor Core-Fuel	1.497%	0.05	2513.0
Reactor Coolant Pumps	1.140%	0.26	382.8
Condenser System	0.973%	0.31	272.4
Reactor Coolant System	0.667%	0.57	101.8
Control Rod Systems	0.313%	0.57	47.8
Sampling System	0.091%	0.05	152.8
On-Site Power Systems	0.090%	0.99	8.0
Auxiliary Feedwater System	0.051%	0.05	84.9
Chemical and Volume Control	0.049%	0.10	41.5
Boric Acid Injection (West.)	0.046%	0.16	25.9
Nuclear Instrumentation	0.045%	0.21	19.0
Reactor Regulating System	0.024%	0.31	6.7
Reactor Protection System	0.018%	0.31	4.9
Engineered Safety Features	0.017%	0.05	28.2
Compressed Air System	0.014%	0.10	11.7
Electrical Distribution System	0.011%	0.10	9.5

Table 2C-19 (Cont'd.)

PWR Unavailability Contributions

For 1974

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Non-Nuclear Instrumentation	0.007%	0.16	3.8
Circulating Water Systems	0.002%	0.05	3.4
TOTALS	22.94 %	13.6	147.6

Table 2C-20

PWR Unavailability Contributions

For 1975

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine Generator System	3.084%	2.47	109.5
Reactor Coolant Pumps	2.351%	0.82	250.4
Main Steam System	1.869%	1.35	121.7
Reactor Coolant System	1.474%	0.97	132.9
Condenser System	1.288%	0.79	143.7
Main Feedwater System	0.830%	4.86	15.0
Control Rod System	0.814%	1.16	61.5
On-Site Power Systems	0.187%	0.37	43.9
Circulating Water Systems	0.129%	0.15	75.6
Engineered Safety Features	0.129%	0.11	100.6
Chemical and Volume Control	0.065%	0.11	50.4
Non-Nuclear Instrumentation	0.064%	0.45	12.5
Emergency Diesel Generators	0.043%	0.11	33.6
Reactor Protection System	0.029%	0.30	8.4
Electrical Distribution System	0.027%	0.22	10.6
Waste Management System	0.027%	0.04	63.8
Reactor Regulating System	0.021%	0.11	16.7
Nuclear Instrumentation	0.002%	0.04	4.1
TOTALS	11.55 %	18.5	101.7

Table 2C-21

PWR Unavailability Contributions

For 1976

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Reactor Vessel Internals	3.491%	0.16	1877.9
Turbine Generator System	3.028%	2.84	93.6
Main Steam System	2.794%	1.21	203.1
Reactor Coolant Pumps	0.917%	0.42	189.6
Main Feedwater System	0.575%	2.71	18.6
Control Rod System	0.448%	0.95	41.6
Nuclear Instrumentation	0.387%	0.39	86.7
Auxiliary Feedwater System	0.368%	0.03	990.4
Engineered Safety Features	0.309%	0.10	277.4
Electrical Distribution System	0.288%	0.16	154.7
Reactor Vessel	0.265%	0.13	178.4
On-Site Power Systems	0.199%	0.65	26.8
Reactor Coolant System	0.164%	0.23	63.0
Emergency Diesel Generators	0.157%	0.07	211.0
Condenser System	0.155%	0.29	46.4
Circulating Water Systems	0.114%	0.13	76.8
Non-Nuclear Instrumentation	0.080%	0.42	16.6
Chemical and Volume Control	0.062%	0.03	166.1
Reactor Protection System	0.048%	0.42	10.0
Boric Acid INjection (West.)	0.043%	0.07	57.7

Table 2C-21 (Cont'd.)

PWR Unavailability Contributions

For 1976

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Shutdown Cooling System	0.035%	0.07	47.1
Reactor Regulating System	0.030%	0.26	10.0
Rod Position Indicating System	0.015%	0.03	41.0
Seismic Restraints	0.014%	0.03	36.8
Compressed Air System	0.013%	0.13	9.0
Sampling System	0.013%	0.03	35.9
Containment Isolation System	0.012%	0.03	32.4
Plant Process Computer	0.007%	0.03	17.8
Loose Parts Monitoring System	0.005%	0.03	12.2
Blowdown System	0.003%	0.03	7.3
TOTALS	13.86 %	16.4	165.1

Table 2C-22

PWR Unavailability Contributions

For 1977

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Main Steam System	3.638%	1.08	295.7
Turbine Generator System	3.083%	3.63	74.4
Reactor Coolant Pumps	0.770%	0.65	103.4
Condenser System	0.609%	0.37	144.7
Main Feedwater System	0.553%	2.64	18.4
Control Rod System	0.384%	0.91	37.1
Reactor Coolant System	0.330%	0.68	42.5
Shutdown Cooling System	0.239%	0.09	246.1
On-Site Power Systems	0.151%	0.54	24.6
Containment Isolation System	0.137%	0.14	84.8
Compressed Air System	0.122%	0.14	75.4
Chemical and Volume Control	0.120%	0.20	53.1
Containment System	0.119%	0.06	184.3
Electrical Distribution System	0.119%	0.23	46.1
Emergency Diesel Generators	0.113%	0.06	174.1
Rod Position Indicating System	0.099%	0.17	51.2
Reactor Protection System	0.091%	0.62	12.8
Circulating Water System	0.091%	0.09	94.1
Non-Nuclear Instrumentation	0.088%	0.28	27.1
Reactor Core-Fuel	0.058%	0.06	89.3

Table 2C-22 (Cont'd.)

PWR Unavailability Contributions

For 1977

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Engineered Safety Features	0.055%	0.09	57.1
Blowdown System	0.053%	0.09	54.6
Reactor Regulating System	0.053%	0.17	27.3
Nuclear Instrumentation	0.039%	0.11	30.4
Containment Ventilation	0.009%	0.03	27.3
Component Cooling Water	0.006%	0.03	18.4
Auxiliary Feedwater System	0.003%	0.03	8.0
Cooling Towers	0.003%	0.03	10.7
TOTALS	10.80 %	13.5	71.6

Table 2C-23
PWR Unavailability Contributions
For 1978

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine Generator System	2.094%	2.84	64.6
Reactor Core-Fuel	2.056%	0.10	1760.1
Main Steam System	1.502%	0.82	160.7
Electrical Distribution System	1.187%	0.36	290.2
Reactor Coolant Pumps	1.144%	0.77	130.6
Reactor Coolant System	0.691%	0.72	84.5
Main Feedwater System	0.529%	2.25	20.6
Control Rod System	0.500%	0.61	71.4
Engineered Safety Features System	0.361%	0.36	88.4
On-Site Power Systems	0.191%	0.74	22.5
Reactor Protection System	0.172%	0.64	23.5
Condenser System	0.103%	0.26	35.2
Seismic Restraints	0.069%	0.05	118.7
Blowdown System	0.063%	0.05	107.4
Circulating and Saltwater System	0.052%	0.28	16.2
Nuclear Instrumentation System	0.043%	0.08	48.8
Reactor Vessel	0.038%	0.03	130.3
Chemical and Volume Control System	0.037%	0.10	31.7
Component Cooling Water System	0.018%	0.10	15.5
Auxiliary Feedwater System	0.015%	0.03	51.3

Table 2C-23 (Cont'd.)
PWR Unavailability Contributions
For 1978

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Emergency Diesel Generators	0.015%	0.03	51.6
Area Monitoring System	0.014%	0.03	48.9
Boric Acid Injection System (W)	0.012%	0.03	40.1
Cooling Tower System	0.012%	0.05	21.3
Demineralized Water System	0.010%	0.03	34.7
Non-Nuclear Process Instrumentation	0.010%	0.08	11.4
Compressed Air System	0.007%	0.05	12.7
Containment System	0.005%	0.05	7.9
Air Purification System	0.003%	0.03	10.6
Loose Parts Monitoring System	0.003%	0.03	8.9
Containment Ventilation System	0.003%	0.03	9.2
Reactor Regulating System	0.002%	0.03	7.7
TOTALS	10.85 %	11.4	162.3

Table 2C-24

PWR Calendar Year Unavailability Contribution

For The Turbine/Generator System

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	2	5.930%	10/3.3	25/8.3	100%
1969	1	5.624%	11/3.7	0/0	100%
1970	3	1.252%	7/2.0	3/0.8	100%
1971	1	4.527%	14/2.4	5/0.9	100%
1972	1	4.881%	24/3.4	9/1.5	100%
1973	1	6.861%	53/4.2	8/0.8	100%
1974	1	8.766%	47/2.5	23/1.2	77%
1975	1	3.084%	69/2.6	24/0.9	89%
1976	2	3.028%	96/3.1	17/0.6	94%
1977	2	3.083%	130/3.7	29/0.8	100%
1978	1	2.094%	111/2.8	50/1.3	95%
TOTAL	1	3.764%	579/3.01	198/1.03	100%

*Rank: 1 is highest unavailability contribution for year,

U means system had no unavailability contribution

Table 2C-25

PWR Calendar Year Unavailability Contribution

For The Main Steam System

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	U	0%	-	-	-
1969	U	0%	-	-	-
1970	2	1.606%	3/0.85	1/0.28	50%
1971	3	0.378%	6/1.03	0/0	67%
1972	3	1.854%	9/1.27	0/0	57%
1973	2	4.251%	20/1.58	3/0.24	73%
1974	2	5.936%	27/1.41	0/0	68%
1975	3	1.869%	34/1.27	3/0.11	61%
1976	3	2.794%	36/1.18	2/0.07	56%
1977	1	3.638%	39/1.11	2/0.06	46%
1978	3	1.502%	32/0.82	9/0.23	58%
TOTAL	2	2.667%	205/1.07	21/0.11	90%

*Rank: 1 is highest unavailability contribution for year,

U means system had no unavailability contribution

Table 2C-26

PWR Calendar Year Unavailability Contribution

For The Reactor Coolant Pumps

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	4	0.738%	2/.67	0/0	33%
1969	6	0.219%	1/.33	1/.33	67%
1970	U	0%	-	-	-
1971	U	0%	-	-	-
1972	U	0%	-	-	-
1973	4	1.132%	2/0.16	0/0	7%
1974	5	1.14%	6/0.31	0/0	27%
1975	2	2.351%	25/0.93	3/0.11	46%
1976	4	0.917%	15/0.49	9/0.29	38%
1977	3	0.770%	23/0.65	5/0.14	43%
1978	5	1.502%	30/0.77	9/0.23	48%
TOTAL	3	1.225%	103/0.54	30/0.16	78%

*Rank: 1 is highest unavailability contribution for year,

U means system had no unavailability contribution

Table 2C-27

PWR Calendar Year Unavailability Contribution

For The Control Rod System

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	3	0.835%	2/.67	1/0.33	67%
1969	4	0.521%	3/1.00	0/0	67%
1970	9	0.010%	1/0.28	0/0	25%
1971	12	0.303%	4/0.69	0/0	50%
1972	2	4.735%	12/1.69	3/0.42	86%
1973	3	2.312%	9/0.71	4/0.32	60%
1974	8	0.313%	11/0.57	4/0.21	45%
1975	7	0.814%	33/1.23	0/0	54%
1976	6	0.448%	32/1.05	7/0.23	50%
1977	6	0.384%	32/0.91	2/0.06	49%
1978	8	0.500%	24/0.61	14/0.36	33%
TOTAL	4	0.772%	166/0.86	35/0.18	80%

*Rank: 1 is highest unavailability contribution for year,

U means system had no unavailability contribution

Table 2C-28

PWR Calendar Year Unavailability Contribution

For The Main Feedwater System

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	8	0.124%	2/0.67	8/2.67	100%
1969	5	0.404%	3/1.00	1/0.33	33%
1970	1	2.163%	7/1.98	8/2.26	100%
1971	4	0.185%	12/2.06	3/0.52	50%
1972	5	1.526%	25/3.53	9/1.27	100%
1973	6	0.785%	30/2.38	16/1.27	80%
1974	3	1.790%	92/4.80	12/0.63	64%
1975	6	0.830%	132/4.93	20/0.75	86%
1976	5	0.575%	91/2.97	41/1.34	84%
1977	5	0.553%	92/2.61	83/2.35	77%
1978	7	0.529%	88/2.25	114/2.92	85%
TOTAL	5	0.762%	575/2.99	318/1.65	100%

*Rank: 1 is highest unavailability contribution for year,

U means system had no unavailability contribution

Table 2C-29

PWR Calendar Year Unavailability Contribution
For The Reactor Coolant System

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	5	0.641%	2/0.67	1/0.33	33%
1969	2	1.935%	3/1.00	0/0	33%
1970	4	0.820%	8/2.26	3/0.85	75%
1971	5	0.147%	3/0.52	3/0.52	50%
1972	7	0.360%	7/0.99	1/0.14	71%
1973	8	0.333%	5/0.40	2/0.16	33%
1974	7	0.667%	15/0.78	4/0.21	45%
1975	4	1.474%	26/0.97	1/0.04	50%
1976	13	0.164%	6/0.20	2/0.07	22%
1977	7	0.330%	24/0.68	1/0.03	49%
1978	6	0.691%	28/0.72	8/0.20	50%
TOTAL	6	0.614%	131/0.68	26/0.14	93%

*Rank: 1 is highest unavailability contribution for year,
U means system had no unavailability contribution

Table 2C-30

PWR Calendar Year Unavailability Contribution

For The Reactor Vessel Internals

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	U	0%	-	-	-
1969	U	0%	-	-	-
1970	U	0%	-	-	-
1971	U	0%	-	-	-
1972	U	0%	-	-	-
1973	5	0.820%	1/0.08	0/0	7%
1974	U	0%	-	-	-
1975	U	0%	-	-	-
1976	1	3.491%	5/0.16	0/0	16%
1977	U	0%	-	-	-
1978	U	0%	-	-	-
TOTAL	7	0.610%	6/0.03	0/0	15%

*Rank: 1 is highest unavailability contribution for year,

U means system had no unavailability contribution

Table 2C-31

PWR Calendar Year Unavailability Contribution

For The Reactor Core/Fuel

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	U	0%	0/0	2/0.67	33%
1969	U	0%	-	-	-
1970	U	0%	-	-	-
1971	U	0%	-	-	-
1972	U	0%	-	-	-
1973	U	0%	-	-	-
1974	4	1.497%	4/0.21	1/0.05	18%
1975	18	0.023%	1/0.04	3/0.11	11%
1976	U	0%	-	-	-
1977	20	0.058%	2/0.06	2/0.06	11%
1978	2	2.056%	4/0.10	57/1.46	35%
TOTAL	8	0.584%	10/0.05	65/0.34	58%

*Rank: 1 is highest unavailability contribution for year,

U means system had no unavailability contribution

Table 2C-32

PWR Calendar Year Unavailability Contribution

For The On-Site Power Systems

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	1	17.618%	4/1.33	3/1.00	67%
1969	8	0.037%	2/0.67	5/1.67	100%
1970	U	0%	-	-	-
1971	2	2.268%	6/1.03	2/0.34	83%
1972	8	0.223%	7/0.99	1/0.14	86%
1973	10	0.216%	18/1.43	2/0.16	47%
1974	10	0.09%	20/1.04	1/0.05	41%
1975	8	0.187%	11/0.41	0/0	25%
1976	12	0.199%	21/0.69	1/0.03	44%
1977	9	0.151%	19/0.54	1/0.03	37%
1978	10	0.09%	20/1.04	1/0.05	41%
TOTAL	9	0.500%	139/0.72	19/0.10	85%

*Rank: 1 is highest unavailability contribution for year,

U means system had no unavailability contribution

Table 2C-33

PWR Calendar Year Unavailability Contribution

For The Condenser System

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	U	0%	0/0	16/5.33	67%
1969	U	0%	0/0	7/2.33	67%
1970	10	0.001%	1/0.28	3/0.85	50%
1971	10	0.034%	1/0.17	9/1.55	50%
1972	13	0.017%	1/0.14	13/1.83	57%
1973	15	0.040%	2/0.16	2/0.16	20%
1974	6	0.973%	8/0.42	14/0.73	32%
1975	5	1.288%	21/0.79	14/0.52	54%
1976	15	0.155%	9/0.29	49/1.60	59%
1977	4	0.609%	13/0.37	26/0.74	60%
1978	12	0.103%	10/0.26	96/2.46	53%
TOTAL	10	0.439%	67/0.35	253/1.31	90%

*Rank: 1 is highest unavailability contribution for year,

U means system had no unavailability contribution

Table 2C-34

PWR Calendar Year Unavailability Contribution
For The Electrical Distribution System

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	U	0%	0/0	7/2.33	33%
1969	10	0.013%	1/0.33	15/5.00	67%
1970	5	0.229%	1/0.28	2/0.56	50%
1971	7	0.063%	1/0.17	1/0.17	33%
1972	6	0.460%	2/0.28	0/0	14%
1973	11	0.125%	4/0.32	0/0	27%
1974	19	0.011%	3/0.16	2/0.10	18%
1975	16	0.027%	5/0.19	1/0.04	18%
1976	10	0.288%	5/0.16	4/0.13	19%
1977	14	0.119%	8/0.23	2/0.06	26%
1978	4	1.187%	14/0.36	2/0.05	23%
TOTAL	11	0.347%	47/0.24	38/0.20	65%

*Rank: 1 is highest unavailability contribution for year,
U means system had no unavailability contribution

Table 2C-35

PWR Calendar Year Unavailability Contribution
For The Chemical and Volume Control System

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	U	0%	-	-	-
1969	U	0%	-	-	-
1970	6	0.048%	1/0.28	0/0	25%
1971	U	0%	-	-	-
1972	U	0%	-	-	-
1973	17	0.017%	2/0.16	0/0	13%
1974	18	0.017%	1/0.05	1/0.05	9%
1975	14	0.040%	2/0.07	2/0.07	7%
1976	9	0.309%	3/0.10	0/0	9%
1977	21	0.055%	2/0.06	1/0.03	9%
1978	9	0.361%	14/0.36	5/0.13	33%
TOTAL	12	0.142%	25/0.13	9/0.05	50%

*Rank: 1 is highest unavailability contribution for year,
U means system had no unavailability contribution

Table 2C-36

PWR Calendar Year Unavailability Contribution

For The Engineered Safety Features System

<u>Year</u>	<u>Rank*</u>	<u>Unavailability Contribution</u>	<u>Shutdowns Total/Average Per Plant Year</u>	<u>Power Reduction Total/Average Per Plant Year</u>	<u>% of Plants Affected</u>
1968	6	0.038%	1/0.33	1/0.33	67%
1969	U	0%	-	-	-
1970	U	0%	-	-	-
1971	6	0.121%	1/0.17	0/0	17%
1972	4	1.607%	1/0.14	0/0	14%
1973	9	0.221%	4/0.32	0/0	27%
1974	12	0.049%	2/0.10	0/0	5%
1975	11	0.065%	3/0.11	0/0	11%
1976	19	0.062%	1/0.03	1/0.03	6%
1977	12	0.120%	6/0.17	2/0.06	20%
1978	18	0.037%	4/0.10	1/0.03	8%
TOTAL	13	0.142%	24/0.12	5/0.03	45%

*Rank: 1 is highest unavailability contribution for year,

U means system had no unavailability contribution

APPENDIX 2D

Commercial Year Data Tables

The tables within this appendix provide the compiled information to support the commercial year availability impact discussed in Section 2.4 of this report.

APPENDIX 2D

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Commercial Year PWR Unavailability Contribution by System

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Table 2D-1

Commercial Year

PWR Plant Availability

<u>Commercial Year</u>	<u>Average Availability</u>	<u>Average Unavailability</u>
1	73.76%	26.24%
2	67.66%	32.23%
3	71.96%	28.04%
4	76.83%	23.17%
5	77.39%	22.61%
6	76.57%	23.43%
7	80.10%	19.90%
8	87.40%	12.60%
9	77.90%	22.10%
10	78.86%	21.14%
11	82.90%	17.10%

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2D-4

Table 2D-2

PWR Unavailability Contributions

for the

1st Commercial Year

SUMMARY

<u>Systems</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	20.526%	20.25	88.9
Refueling	0.	0.	0.
Regulatory/Administrative	0.066%	0.92	6.3
Personnel Error	0.302%	1.50	17.6
External Causes	0.151%	0.53	25.2
Other	5.192%	7.79	58.4
Total	26.237%	30.99	74.2

Table 2D-3
 PWR Unavailability Contributions
 for the
 2nd Commercial Year
 SUMMARY

<u>Systems</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total System	16.681%	13.88	105.3
Refueling	11.458%	0.61	1656.4
Regulatory/Administrative	0.088%	0.18	42.6
Personnel Error	0.131%	1.33	8.6
External	0.047%	0.33	12.3
Other	3.822%	3.18	105.4
Total	32.227%	19.51	144.8

Table 2D-4
 PWR Unavailability Contributions
 for the
 3rd Commercial Year
 SUMMARY

<u>Systems</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	8.054%	11.55	81.1
Refueling	17.122%	1.03	1452.6
Regulatory/Administrative	1.948%	0.13	1280.8
Personnel Error	0.054%	0.73	6.5
External Causes	0.023%	0.20	10.0
Other	0.839%	3.60	20.4
Total	28.040%	17.24	142.6

Table 2D-5
PWR Unavailability Contributions
for the
4th Commercial Year
SUMMARY

<u>Systems</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total System	11.126%	10.28	94.9
Refueling	10.490%	0.80	1149.0
Regulatory/Administrative	0.075%	0.56	11.7
Personnel Error	0.057%	0.64	7.8
External Causes	0.074%	0.16	40.3
Other	1.343%	1.24	94.9
Total	23.165%	13.68	148.4

Table 2D-6

PWR Unavailability Contributions

for the

5th Commercial Year

SUMMARY

<u>Systems</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total System	8.090%	10.63	66.7
Refueling	14.211%	1.06	1176.5
Regulatory/Administrative	0.	0.	0.
Personnel Error	0.066%	0.41	14.1
External Causes	0.019%	0.12	13.6
Other	0.229%	0.89	22.6
Total	22.615%	13.11	151.2

Table 2D-7
PWR Unavailability Contributions
for the
6th Commercial Year
SUMMARY

<u>Systems</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total System	12.982%	8.90	127.9
Refueling	10.044%	0.90	978.2
Regulatory/Administrative	0.091%	0.10	80.1
Personnel Error	0.007%	0.30	2.2
External Causes	0.190%	0.50	33.2
Other	0.114%	1.10	9.1
Total	23.428%	11.8	174.0

Table 2D-8

PWR Unavailability Contributions

for the

7th Commercial Year

SUMMARY

<u>Systems</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total System	10.288%	8.5	105.5
Refueling	9.343%	0.7	1146.3
Regulatory/Administrative	0.015%	0.1	9.0
Personnel Error	0.	0.	0.
External Causes	9.050%	0.6	7.7
Other	0.266%	1.4	16.7
Total	19.902%	11.3	154.4

Table 2D-9
PWR Unavailability Contributions
for the
8th Commercial Year
SUMMARY

<u>Systems</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total System	3.433%	5.2	57.9
Refueling	9.011%	0.8	986.7
Regulatory/Administrative	0.025%	0.2	11.6
Personnel Error	0.	0.	0.
External Causes	0.	0.	0.
Other	0.131%	0.6	19.2
Total	12.600%	6.8	162.4

Table 2D-10

PWR Unavailability Contributions

for the

9th Commercial Year

SUMMARY

<u>Systems</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total Systems	2.703%	6.8	34.8
Refueling	18.898%	1.0	1658.5
Regulatory/Administrative	0.054%	0.3	14.2
Personnel Error	0.027%	0.3	7.0
External Causes	0.074%	0.7	9.8
Other	0.343%	1.6	18.8
Total	22.099%	10.7	181.0

Table 2D-11
PWR Unavailability Contributions
for the
10th Commercial Year
SUMMARY

<u>Systems</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total System	4.167%	6.9	52.9
Refueling	16.800%	1.0	1471.7
Regulatory/Administrative	0.	0.	0.
Personnel Error	0.016%	0.3	4.0
External Causes	0.	0.	0.
Other	0.160%	1.6	8.8
Total	21.143%	9.8	189.1

Table 2D-12

PWR Unavailability Contributions

for the

11th Commercial Year

SUMMARY

<u>Systems</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Total System	11.968%	7.0	149.9
Refueling	4.620%	0.3	1214.7
Regulatory/Administrative	0.346%	1.0	30.3
Personnel Error	0.	0.	0.
External Causes	0.045%	0.7	5.1
Other	0.125%	0.6	18.3
Total	17.104%	9.6	156.2

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Table 2D-13

PWR Unavailability Contributions

for the

1st Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine/Generator	7.370%	5.00	129.2
Main Feedwater	2.048%	5.79	31.0
On-Site Power	1.995%	0.95	184.6
Reactor Coolant Pumps	1.870%	0.63	259.5
Reactor Coolant System	1.469%	1.29	99.8
Main Steam System	1.268%	1.16	96.0
Control Rod System	0.983%	1.45	59.5
Reactor Core/Fuel	0.893%	0.11	743.7
Condenser	0.438%	0.66	58.4
Chemical and Volume Control	0.427%	0.13	284.3
Electrical Distribution	0.353%	0.45	69.2
Auxiliary Feedwater	0.337%	0.08	374.2
Seismic Restraints	0.240%	0.08	266.0
Circulating/Saltwater	0.182%	0.42	37.8
Reactor Protection System	0.150%	0.61	21.8
Emergency Diesel Generators	0.138%	0.08	153.1
Compressed Air	0.120%	0.16	66.9
Reactor Regulating	0.053%	0.26	17.5
Nuclear Instrumentation	0.037%	0.13	24.5

Table 2D-13 (Cont'd.)
PWR Unavailability Contributions
for the
1st Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Engineered Safety Features	0.036%	0.16	20.2
Containment Isolation	0.030%	0.08	33.8
Non-Nuclear Process Instrument	0.025%	0.32	6.9
Rod Position Indicating	0.019%	0.05	31.6
Boric Acid Injection	0.017%	0.05	28.6
Containment Systems	0.009%	0.03	31.0
Shutdown Cooling	0.008%	0.03	26.7
Component Cooling Water	0.006%	0.03	18.4
Containment Ventilation	0.003%	0.03	9.2
Turbine Bypass	0.002%	0.03	1.2
Total	20.526%	20.25	88.9

Table 2D-14
PWR Unavailability Contributions
for the
2nd Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine/Generator	3.535%	3.42	90.4
Reactor Vessel Internals	2.980%	0.15	1723.0
Reactor Coolant Pumps	2.441%	0.73	294.1
Main Steam	1.958%	0.73	235.9
Reactor Core/Fuel	0.870%	0.06	1257.0
Reactor Coolant System	0.863%	0.88	86.0
Main Feedwater	0.682%	3.06	19.5
Electrical Distribution	0.639%	0.21	263.7
Condenser	0.534%	0.42	112.2
Control Rod Systems	0.501%	0.97	45.3
Nuclear Instrumentation	0.312%	0.27	100.2
On-Site Power	0.309%	0.91	29.8
Circulating/Saltwater	0.177%	0.15	102.1
Non-Nuclear Process Instru.	0.166%	0.36	40.0
Emergency Diesel Generator	0.120%	0.06	173.2
Engineered Safety Features	0.092%	0.09	88.9
Reactor Vessel	0.088%	0.06	127.0
Chemical and Volume Control	0.087%	0.12	63.1
Rod Position Indicating	0.077%	0.12	56.0

Table 2D-14 (Cont'd.)

PWR Unavailability Contributions

for the

2nd Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Sampling System	0.053%	0.03	152.8
Auxiliary Feedwater	0.048%	0.06	68.9
Reactor Protection	0.036%	0.36	8.7
Blowdown	0.027%	0.09	26.4
Reactor Regulating	0.024%	0.18	11.4
Cooling Tower	0.015%	0.06	21.3
Compressed Air	0.010%	0.09	9.7
Component Cooling Water	0.008%	0.06	11.8
Boric Acid Injection	0.007%	0.03	20.5
Containment Isolation	0.007%	0.03	19.8
Plant Process Computer	0.006%	0.03	17.8
Containment Systems	0.005%	0.06	7.9
Loose Parts Monitoring	0.004%	0.03	12.2
Total	16.681%	13.88	105.3

Table 2D-15
PWR Unavailability Contributions
for the
3rd Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Main Steam	3.559%	1.20	260.0
Turbine Generator	1.231%	2.27	47.6
Condenser	0.604%	0.23	227.0
Main Feedwater	0.558%	3.30	14.8
Reactor Vessel Internals	0.393%	0.03	1033.7
Reactor Coolant Pumps	0.261%	0.43	52.7
Reactor Coolant System	0.249%	0.63	34.5
Control Rod System	0.247%	0.67	32.5
Containment Systems	0.220%	0.10	192.7
Reactor Vessel	0.159%	0.10	139.4
On-Site Power	0.117%	0.77	13.3
Chemical and Volume Control	0.091%	0.17	47.8
Nuclear Instrumentation	0.062%	0.20	27.2
Engineered Safety Features	0.057%	0.07	75.0
Electrical Distribution	0.053%	0.20	23.8
Reactor Protection	0.052%	0.40	11.5
Non-Nuclear Process Instrument	0.032%	0.33	8.3
Shutdown Cooling	0.024%	0.07	31.3
Rod Position Indicating	0.014%	0.03	37.3

Table 2D-15 (Cont'd.)

PWR Unavailability Contributions

for the

3rd Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Emergency Diesel Generators	0.014%	0.03	37.2
Sampling System	0.014%	0.03	35.9
Demineralized Water	0.013%	0.03	34.7
Containment Isolation	0.012%	0.03	32.4
Reactor Regulating	0.011%	0.17	5.8
Blowdown	0.004%	0.03	12.4
Compressed Air	0.003%	0.03	8.7
Total	8.054%	11.55	81.1

Table 2D-16

PWR Unavailability Contributions

for the

4th Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Main Steam	4.769%	1.52	275.0
Turbine/Generator	2.176%	2.24	47.2
Reactor Coolant Pumps	1.266%	0.64	173.3
Condenser	1.052%	0.28	329.3
Control Rod System	0.611%	0.88	60.9
Reactor Coolant System	0.385%	0.44	76.6
Main Feedwater	0.278%	1.68	14.5
Blowdown	0.096%	0.08	105.4
Reactor Vessel	0.078%	0.08	85.8
Reactor Protection	0.057%	0.56	8.9
Engineered Safety Features	0.055%	0.04	120.0
Chemical and Volume Control	0.046%	0.12	33.7
On-Site Power	0.046%	0.64	6.3
Reactor Core/Fuel	0.043%	0.04	93.4
Electrical Distribution	0.040%	0.20	17.7
Nuclear Instrumentation	0.030%	0.24	10.9
Non-Nuclear Process Instrument	0.023%	0.20	10.0
Shutdown Cooling	0.018%	0.04	40.0
Seismic Restraints	0.017%	0.04	36.8

Table 2D-16 (Cont'd.)

PWR Unavailability Contributions

for the

4th Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Emergency Diesel Generator	0.013%	0.04	28.2
Compressed Air	0.012%	0.08	13.0
Reactor Regulating	0.005%	0.08	6.0
Containment Air Purification	0.005%	0.04	10.6
Auxiliary Feedwater	0.004%	0.04	8.0
Circulating/Saltwater	0.001%	0.04	3.0
Total	11.126%	10.28	94.9

Table 2D-17

PWR Unavailability Contributions

for the

5th Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Main Steam	4.700%	1.18	350.2
Reactor Coolant Pumps	0.971%	0.53	160.8
Turbine Generator	0.687%	2.60	23.3
Reactor Coolant System	0.355%	0.47	66.1
Main Feedwater	0.324%	2.18	13.0
Control Rod System	0.273%	0.59	40.7
Condenser	0.147%	0.41	31.3
Chemical and Volume Control	0.143%	0.12	106.6
On-Site Power	0.127%	0.88	12.6
Electrical Distribution	0.087%	0.12	65.0
Reactor Protection	0.082%	0.47	15.2
Reactor Core/Fuel	0.057%	0.06	85.1
Emergency Diesel Generator	0.035%	0.06	51.6
Boric Acid Injection	0.027%	0.06	40.1
Non-Nuclear Process Instrument	0.019%	0.18	7.6
Circulating/Saltwater	0.017%	0.12	13.0
Nuclear Instrumentation	0.013%	0.18	6.5
Compressed Air	0.008%	0.24	3.1

Table 2D-17 (Cont'd.)
 PWR Unavailability Contributions
 for the
 5th Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Engineered Safety Features	0.007%	0.06	11.1
Loose Parts Monitoring	0.006%	0.06	8.9
Reactor Regulating	0.005%	0.06	7.7
Total	8.090%	10.63	66.7

Table 2D-18

PWR Unavailability Contributions

for the

6th Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine Generator	9.013%	2.60	303.9
Main Steam	1.992%	0.80	218.2
Electrical Distribution	0.456%	0.30	133.3
Reactor Coolant Pumps	0.372%	0.30	108.6
Main Feedwater	0.308%	2.10	12.9
Control Rod System	0.298%	0.40	65.3
Containment Isolation	0.256%	0.10	224.3
Reactor Coolant System	0.075%	0.10	65.1
Circulating/Saltwater	0.050%	0.10	43.5
Condenser	0.047%	0.20	20.5
Reactor Protection	0.041%	0.80	4.5
On-Site Power	0.031%	0.80	3.4
Nuclear Instrumentation	0.017%	0.10	14.7
Engineered Safety Features	0.014%	0.10	12.3
Cooling Tower	0.012%	0.10	10.7
Total	12.982%	8.9	127.9

Table 2D-19
PWR Unavailability Contributions
for the
7th Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine/Generator	3.670%	1.30	250.1
Control Rod System	2.233%	2.60	76.1
Main Steam	1.452%	0.90	148.5
Shutdown Cooling	1.175%	0.30	360.4
Engineered Safety Features	0.833%	0.10	511.0
Reactor Coolant Pumps	0.434%	0.30	133.1
Main Feedwater	0.217%	1.90	10.2
Reactor Coolant System	0.082%	0.10	50.6
Reactor Protection	0.044%	0.60	6.7
Nuclear Instrumentation	0.038%	0.10	23.6
On-Site Power	0.033%	0.10	20.1
Condenser	0.013%	0.10	7.8
Compressed Air	0.004%	0.10	2.6
Total	10.228%	8.5	105.5

Table 2D-20

PWR Unavailability Contributions

for the

8th Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Main Steam	1.936%	1.8	94.2
Reactor Coolant Pumps	0.444%	0.4	97.2
Reactor Coolant System	0.334%	0.4	73.2
Main Feedwater	0.209%	0.4	45.8
Electrical Distribution	0.173%	0.2	75.9
Turbine Generator	0.104%	0.4	11.4
Chemical and Volume Control	0.089%	0.2	39.0
Control Rod System	0.068%	0.2	30.0
Shutdown Cooling	0.040%	0.2	17.5
Circulating/Saltwater	0.023%	0.2	10.1
Non-Nuclear Process Instrument	0.008%	0.2	3.7
Nuclear Instrumentation	0.005%	0.6	0.7
Total	3.433%	5.2	57.9

Table 2D-21
PWR Unavailability Contributions
for the
9th Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Main Steam	1.357%	1.3	89.4
Blowdown	0.662%	0.3	174.4
Turbine/Generator	0.315%	2.3	13.3
Main Feedwater	0.159%	0.3	41.8
Non-Nuclear Process Instrument	0.132%	1.3	8.7
On-Site Power Systems	0.040%	0.7	5.3
Nuclear Instrumentation	0.023%	0.3	6.1
Reactor Protection	0.015%	0.3	3.9
Total	2.703%	6.8	34.8

Table 2D-22

PWR Unavailability Contributions

for the

10th Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Main Steam	3.391%	1.0	445.6
Turbine/Generator	0.354%	3.3	9.3
Containment Ventilation	0.104%	0.3	27.3
Rod Position Indicating	0.098%	0.3	25.7
Engineered Safety Features	0.095%	0.3	24.9
Control Rod System	0.092%	0.7	12.1
Reactor Protection	0.022%	0.7	2.9
Non-Nuclear Process Instrument	0.011%	0.3	2.9
Total	4.167%	6.9	52.9

Table 2D-23
PWR Unavailability Contributions
for the
11th Commercial Year

<u>System</u>	<u>Average Unavailability Contribution Per Plant Year</u>	<u>Average Number of Shutdowns Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>
Turbine/Generator	9.707%	3.3	255.3
Main Steam	0.998%	0.7	131.2
Reactor Coolant	0.921%	0.7	121.1
Engineered Safety Features	0.195%	0.3	51.4
Non-Nuclear Process Instrument	0.051%	0.7	6.7
Reactor Protection	0.047%	0.3	12.3
Main Feedwater	0.038%	0.7	5.1
On-Site Power	0.011%	0.3	2.8
Total	11.968%	7.0	149.9

Table 2D-24

Plant Unavailability Contribution
by Commercial Year
For The Turbine/Generator System

2D-33	<u>Commercial Year</u>	<u>Rank</u>	<u>Average Unavailability Contribution</u>	<u>Shutdowns Per Plant Year</u>	<u>Scrams Per Plant Year</u>	<u>Power Reductions Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Percent of Plants Affected</u>
	1	1	7.370%	5.00	2.31	1.32	129.2	95
	2	1	3.535%	3.42	1.70	0.30	90.4	91
	3	2	1.231%	2.27	1.27	0.47	47.6	93
	4	2	2.176%	2.24	0.81	0.48	47.2	88
	5	3	0.687%	2.60	1.40	1.06	23.3	94
	6	1	9.013%	2.60	0.80	1.10	303.9	90
	7	1	3.670%	1.30	0.43	3.40	250.1	100
	8	6	0.104%	0.40	0.	2.40	11.4	80
	9	3	0.315%	2.30	1.20	1.00	13.3	100
	10	2	0.354%	3.30	1.00	2.30	9.3	100
	11	1	9.707%	3.30	0.66	3.00	255.3	100

Table 2D-25

Plant Unavailability Contribution

by Commercial Year

For The Main Steam System

2D-34

<u>Commercial Year</u>	<u>Rank</u>	<u>Average Unavailability Contribution</u>	<u>Shutdowns Per Plant Year</u>	<u>Scrams Per Plant Year</u>	<u>Power Reductions Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Percent of Plants Affected</u>
1	6	1.268%	1.16	0.76	0.18	96.0	61
2	4	1.958%	0.73	0.36	0.	235.9	39
3	1	3.559%	1.20	0.30	0.03	260.0	57
4	1	4.769%	1.52	0.13	0.07	275.0	43
5	1	4.700%	1.18	0.17	0.12	350.2	65
6	2	1.992%	0.80	0.10	0.10	218.2	70
7	3	1.452%	0.90	0.38	0.	148.5	71
8	1	1.936%	1.80	0.51	0.20	94.2	60
9	1	1.357%	1.30	0.20	0.	89.4	100
10	1	3.391%	1.00	0.20	0.30	445.6	100
11	2	0.998%	0.70	0.	0.	131.2	67

Table 2D-26

Plant Unavailability Contribution
by Commercial Year
For The Reactor Coolant Pumps

2D-35

<u>Commercial Year</u>	<u>Rank</u>	<u>Average Unavailability Contribution</u>	<u>Shutdowns Per Plant Year</u>	<u>Scrams Per Plant Year</u>	<u>Power Reductions Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Percent of Plants Affected</u>
1	4	1.870%	0.63	0.11	0.05	259.5	32
2	3	2.441%	0.73	0.24	0.21	294.1	33
3	6	0.261%	0.43	0.11	0.20	52.7	40
4	4	1.266%	0.64	0.16	0.56	173.3	56
5	2	0.971%	0.53	0.12	0.06	160.8	41
6	4	0.372%	0.30	0.15	0.	108.6	20
7	6	0.434%	0.30	0.08	0.	133.1	14
8	2	0.444%	0.40	0.40	0.	97.2	20
9	-	0.	0.	0.	0.70	0.	33
10	-	0.	0.	0.	0.	0.	-
11	-	0.	0.	0.	0.	0.	-

Table 2D-27

Plant Unavailability Contribution
by Commercial Year
For The Control Rod System

<u>Commercial Year</u>	<u>Rank</u>	<u>Average Unavailability Contribution</u>	<u>Shutdowns Per Plant Year</u>	<u>Scrams Per Plant Year</u>	<u>Power Reductions Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Percent of Plants Affected</u>
1	7	0.983%	1.45	0.95	0.18	59.5	61
2	10	0.501%	0.97	0.63	0.21	45.3	70
3	8	0.247%	0.67	0.54	0.10	32.5	43
4	5	0.611%	0.88	0.04	0.24	60.9	36
5	6	0.273%	0.59	0.35	0.06	40.7	47
6	6	0.298%	0.40	0.20	0.40	65.3	60
7	2	2.233%	2.60	0.72	0.	76.1	57
8	8	0.068%	0.20	0.	0.	30.0	20
9	-	0.	0.	0.	0.	0.	0
10	6	0.092%	0.70	0.20	0.	12.1	33
11	-	0.	0.	0.	0.	0.	0

Table 2D-28

Plant Unavailability Contribution
by Commercial Year
For The Main Feedwater System

<u>Commercial Year</u>	<u>Rank</u>	<u>Average Unavailability Contribution</u>	<u>Shutdowns Per Plant Year</u>	<u>Scrams Per Plant Year</u>	<u>Power Reductions Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Percent of Plants Affected</u>
1	2	2.048%	5.79	5.75	3.32	31.0	87
2	7	0.682%	3.06	2.60	1.64	19.5	88
3	4	0.558%	3.30	2.70	0.70	14.8	80
4	7	0.278%	1.68	1.42	1.08	14.5	72
5	5	0.324%	2.18	1.65	1.00	13.0	82
6	5	0.308%	2.10	1.40	0.90	12.9	80
7	7	0.217%	1.90	1.14	0.70	10.2	43
8	4	0.209%	0.40	0.20	0.80	45.8	40
9	4	0.159%	0.30	0.	0.70	41.8	33
10	-	0.	0.	0.	1.00	0.	33
11	7	0.038%	0.70	0.70	1.00	5.1	100

Table 2D-29

Plant Unavailability Contribution
by Commercial Year
For The Reactor Coolant System

Commercial Year	Rank	Average Unavailability Contribution	Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration (Hours)	Percent of Plants Affected
1	5	1.469%	1.29	0.21	0.13	99.8	58
2	6	0.863%	0.88	0.15	0.15	86.0	58
3	7	0.249%	0.63	0.	0.07	34.5	30
4	6	0.385%	0.44	0.14	0.04	76.6	32
5	4	0.355%	0.47	0.06	0.	66.1	41
6	8	0.075%	0.10	0.	0.	65.1	10
7	7	0.082%	0.10	0.	0.	50.6	14
8	3	0.334%	0.40	0.	0.	73.2	40
9	-	0.	0.	0.	1.00	0.	67
10	-	0.	0.	0.	1.00	0.	33
11	3	0.921%	0.70	0.	1.00	121.1	100

Table 2D-30

Plant Unavailability Contribution
by Commercial Year
For The On-Site Power Systems

2D-39	<u>Commercial Year</u>	<u>Rank</u>	<u>Average Unavailability Contribution</u>	<u>Shutdowns Per Plant Year</u>	<u>Scrams Per Plant Year</u>	<u>Power Reductions Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Percent of Plants Affected</u>
	1	3	1.995%	0.95	0.85	0.08	184.6	47
	2	12	0.309%	0.91	0.78	0.21	29.8	55
	3	11	0.117%	0.77	0.67	0.13	13.3	40
	4	13	0.046%	0.64	0.55	0.08	6.3	40
	5	9	0.127%	0.88	0.69	0.06	12.6	53
	6	12	0.031%	0.80	0.30	0.10	3.4	40
	7	11	0.033%	0.10	0.10	0.	20.1	14
	8	-	0.	0.	0.	0.	0.	0
	9	6	0.040%	0.70	0.33	0.30	5.3	67
	10	-	0.	0.	0.	0.30	0.	33
	11	8	0.011%	0.30	0.30	0.	2.8	33

Table 2D-31

Plant Unavailability Contribution
by Commercial Year
For The Condenser System

2D-40	<u>Commercial Year</u>	<u>Rank</u>	<u>Average Unavailability Contribution</u>	<u>Shutdowns Per Plant Year</u>	<u>Scrams Per Plant Year</u>	<u>Power Reductions Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Percent of Plants Affected</u>
	1	9	0.438%	0.66	0.18	0.58	58.4	58
	2	9	0.534%	0.42	0.06	1.03	112.2	45
	3	3	0.604%	0.23	0.07	0.30	227.0	40
	4	4	1.052%	0.28	0.12	1.20	329.3	56
	5	7	0.147%	0.41	0.12	1.35	31.3	59
	6	10	0.047%	0.20	0.	6.30	20.5	60
	7	12	0.013%	0.10	0.10	2.30	7.8	43
	8	-	0.	0.	0.	1.80	0.	40
	9	-	0.	0.	0.	0.70	0.	67
	10	-	0.	0.	0.	0.30	0.	33
	11	-	0.	0.	0.	2.70	0.	67

Table 2D-32

Plant Unavailability Contribution
by Commercial Year
For The Electrical Distribution System

2D-41	<u>Commercial Year</u>	<u>Rank</u>	<u>Average Unavailability Contribution</u>	<u>Shutdowns Per Plant Year</u>	<u>Scrams Per Plant Year</u>	<u>Power Reductions Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Percent of Plants Affected</u>
	1	11	0.353%	0.45		0.21	69.2	37
	2	8	0.639%	0.21		0.52	263.7	21
	3	15	0.052%	0.20		0.03	23.8	20
	4	14	0.040%	0.20		0.08	17.7	20
	5	10	0.087%	0.12		0.06	65.0	18
	6	3	0.456%	0.30		0.40	133.3	40
	7	-	0.	0.	0.	0.30	0.	14
	8	5	0.173%	0.20		0.	75.9	20
	9	-	0.	0.	0.	0.70	0.	33
	10	-	0.	0.	0.	0.	0.	0
	11	-	0.	0.	0.	0.30	0.	33

Table 2D-33

Plant Unavailability Contribution
by Commercial Year
For The Engineered Safety Features Systems

Commercial Year	Rank	Average Unavailability Contribution	Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration (Hours)	Percent of Plants Affected
1	20	0.036%	0.16		0.	20.2	11
2	16	0.092%	0.09		0.06	88.9	9
3	14	0.057%	0.07		0.	75.0	7
4	11	0.055%	0.04		0.08	120.0	8
5	19	0.007%	0.06		0.06	11.1	12
6	14	0.014%	0.10		0.10	12.3	20
7	5	0.833%	0.10		0.	511.0	14
8	-	0.	0.	0.	0.20	0.	20
9	-	0.	0.	0.	0.	0.	0
10	5	0.095%	0.30		0.	24.9	33
11	4	0.195%	0.30		0.	51.4	33

2D-42

Table 2D-34

Plant Unavailability Contribution
by Commercial Year
For The Chemical and Volume Control System

2D-43/2D-44	<u>Commercial Year</u>	<u>Rank</u>	<u>Average Unavailability Contribution</u>	<u>Shutdowns Per Plant Year</u>	<u>Scrams Per Plant Year</u>	<u>Power Reductions Per Plant Year</u>	<u>Average Shutdown Duration (Hours)</u>	<u>Percent of Plants Affected</u>
	1	10	0.427%	0.13	0.08	0.03	284.3	13
	2	18	0.087%	0.12	0.	0.03	63.1	15
	3	12	0.091%	0.17	0.06	0.03	47.8	17
	4	12	0.046%	0.10	0.	0.03	33.7	13
	5	8	0.143%	0.12	0.	0.	106.6	12
	6	-	0.	0.	0.	0.	0.	0
	7	-	0.	0.	0.	0.	0.	0
	8	7	0.089%	0.20	0.20	0.20	39.0	40
	9	-	0.	0.	0.	0.	0.	0
	10	-	0.	0.	0.	0.	0.	0
	11	-	0.	0.	0.	0.	0.	0

APPENDIX 2E

Calendar Year PWR Problem Profiles Data Tables

The appendix contains the calendar year problem contributions for the years 1968 thru 1978. These tables list the average annual impact of each problem and a total impact for the eleven year period along with the number of plants affected.

NOTE: Units for average shutdown duration is hours.

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Table 2E-1

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Turbine Blade Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	3.948%	0.17	0	0	2014.6	1/6
1972	0%	0	0	0	0	0
1973	2.35%	0.24	0.08	0	867.7	3/15
1974	6.839%	0.47	0.26	0	1276.0	7/22
1975	2.064%	0.11	0.04	0	1611.7	3/28
1976	1.556%	0.07	0	0	2092.2	3/32
1977	0.565%	0.06	0	0	872.2	2/35
1978	0%	0	0	0	0	0
TOTAL	1.592%	0.10	0.04	0	1343.3	15/40

* Hours

Table 2E-2

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = MISC Turbine/Generator Mechanical Problems/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.542%	0.28	0	0	168.0	1/4
1971	0.141%	0.17	0	0	72.0	1/6
1972	0%	0	0	0	0	0
1973	2.563%	0.40	0.16	0	566.9	3/15
1974	1.468%	0.10	0.05	0.05	1232.4	3/22
1975	0.172%	0.19	0.04	0.04	80.4	5/28
1976	0.267%	0.23	0.03	0	102.5	5/32
1977	1.041%	0.26	0.03	0	357.3	9/35
1978	0.429%	0.28	0.13	0.13	133.5	9/40
TOTAL	0.672%	0.21	0.06	0.04	276.6	24/40

* Hours

Table 2E-3

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Turbine Bearing Failures/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.331%	0.08	0	0	366.0	1/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.428%	0.10	0.03	0.07	383.5	4/32
1977	0.001%	0.03	0.03	0	3.2	1/35
1978	0.892%	0.18	0.03	436.0	3.2	1/35
TOTAL	0.271%	0.06	0.02	0.01	381.0	11/40

* Hours

Table 2E-4

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Misc. Turbine Control/Stop Valve Malfunctions/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	1.598%	1.00	0	0.67	140.3	1/3
1969	0.416%	1.00	0.33	0	36.4	1/3
1970	0.151%	0.28	0	0	46.9	1/4
1971	0%	0	0	0	0	0
1972	0.422%	0.56	0	0	65.7	0
1973	0.001%	0.08	0.08	0.08	1.0	2/15
1974	0.052%	0.10	0.05	0.16	44.1	4/22
1975	0.084%	0.19	0.11	0.04	39.3	6/28
1976	0.173%	0.29	0.13	0.09	51.6	6/32
1977	0.570%	0.31	0.09	0.03	160.1	9/35
1978	0.056%	0.15	0.05	0.03	31.9	6/4
TOTAL	0.210%	0.23	0.08	0.05	78.7	21/40

* Hours

Table 2E-5

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Generator Stator Winding Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	3.72%	0.14	0.14	0	2318.4	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.077%	0.03	0.03	0	206.9	1/32
1977	0%	0	0	0	0	0
1978	0.105%	0.03	0	0	358.9	1/40
TOTAL	0.171%	0.02	0.01	0	961.4	3/40

* Hours

Table 2E-6

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Turbine Generator Inspections and Tests

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	4.627%	0.33	0	0	1216.1	1/3
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.019%	0.10	0.05	0.31	15.9	3/22
1975	0.007%	0.04	0	0.11	16.0	4/28
1976	0.013%	0.16	0.07	0.03	6.8	5/32
1977	2.092%	0.43	0.09	0	18.9	13/35
1978	0.179%	0.51	0.13	0.08	30.7	16/40
TOTAL	0.130%	0.23	0.06	0.07	49.9	28/40

* Hours

Table 2E-7

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = General Moisture Separator/Reheater Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.077%	0.28	0	0	24.0	1/4
1971	0.103%	0.17	0	0	52.8	1/6
1972	0.080%	0.14	0	0	52.8	1/6
1973	0.348%	0.24	0.08	0	128.4	3/15
1974	0%	0	0	0.10	0	2/22
1975	0.011%	0.04	0	0	26.6	2/32
1976	0.020%	0.07	0	0	26.6	2/32
1977	0.266%	0.11	0	0	205.3	3/35
1978	0.144%	0.10	0	0.05	122.9	4/40
TOTAL	0.113%	0.09	0.01	0.02	112.0	13/40

* Hours

Table 2E-8

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = EHC Auto-Stop Oil/Fluid System Malfunctions

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0.023%	0.33	0	0	6.0	1/3
1969	0.193%	0.67	0	0	25.3	2/3
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.003%	0.28	0.14	0	0.9	2/7
1973	0.561%	0.55	0.40	0	88.7	4/15
1974	0.052%	0.10	0.05	0	43.6	2/22
1975	0.028%	0.30	0.19	0.07	8.3	6/28
1976	0.053%	0.36	0.10	0	12.9	6/32
1977	0.036%	0.45	0.34	0.03	6.9	9/35
1978	0.068%	0.20	0.13	0.03	29.1	6/40
TOTAL	0.072%	0.30	0.17	0.02	21.2	25/40

* Hours

Table 2E-9

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Turbine Piping/Casing Steam Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	3.191%	1.00	0	0.67	280.3	3/3
1969	0.046%	0.33	0	0	12.0	1/3
1970	0%	0	0	0	0	0
1971	0.016%	0.17	0	0.34	8.1	3/6
1972	0.016%	0.14	0	0	10.0	1/7
1973	0.062%	0.24	0	0	22.7	3/15
1974	0.036%	0.10	0	0	30.2	2/22
1975	0.033%	0.11	1	0.07	25.7	4/28
1976	0.014%	0.20	0.03	0.13	6.5	5/32
1977	0.018%	0.14	0	0.09	11.2	8/35
1978	0.013%	0.10	0	0.03	11.3	4/40
TOTAL	0.072%	0.15	0.01	0.07	41.9	19/40

* Hours

Table 2E-10

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Generator Exciter Malfunctions

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.024%	0.17	0.17	0	12.0	1/6
1972	0.013%	0.54	0.28	0	4.0	1/7
1973	0.058%	0.08	0	0	64.0	1/15
1974	0.121%	0.10	0.10	0	101.7	2/22
1975	0%	0	0	0	0	0
1976	0.220%	0.16	0.10	0.03	118.1	5/32
1977	0.040%	0.14	0.06	0	25.0	2/35
1978	0.024%	0.05	0	0	40.7	2/40
TOTAL	0.064%	0.09	0.05	0.01	60.2	12/40

* Hours

Table 2E-11

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Generator Hydrogen Cooling System Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0.218%	0.33	0	0	57.3	1/3
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.170%	0.28	0	0.28	52.8	1/7
1973	0.019%	0.16	0.08	0	10.7	1/15
1974	0.021%	0.05	0	0	35.3	1/22
1975	0.113%	0.11	0.07	0	88.5	3/28
1976	0%	0	0	0	0	0
1977	0.098%	0.06	0	0.03	151.8	3/35
1978	0.006%	0.05	0.03	0	10.8	2/40
TOTAL	0.048%	0.06	0.02	0.02	67.5	9/40

* Hours

Table 2E-12

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Misc. EHC System Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	<0.001%	0.28	0	0	0.1	1/4
1971	0.004%	0.17	0.17	0.17	2.0	2/6
1972	0.001%	0.14	0.14	0	0.8	1/7
1973	0.066%	0.55	0.40	0.16	10.4	6/15
1974	0.039%	0.37	0.31	0.05	9.3	6/22
1975	0.100%	0.49	0.37	0.04	18.1	7/28
1976	0.050%	0.29	0.23	0	15.0	5/32
1977	0.028%	0.23	0.17	0	10.9	6/35
1978	0.025%	0.18	0.13	0.03	12.3	8/40
TOTAL	0.041%	0.28	0.21	0.04	12.7	25/40

* Hours

Table 2E-13

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Turbine/Generator Balancing

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.336%	0.40	0	0	74.2	1/15
1974	0%	0	0	0	0	0
1975	0.014%	0.04	0.04	0	32.7	1/28
1976	0%	0	0	0	0	0
1977	0.028%	0.20	0.03	0	12.5	3/35
1978	0.047%	0.26	0.05	0	16.0	8/40
TOTAL	0.039%	0.12	0.02	0	28.3	10/40

* Hours

Table 2E-14

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Moisture Separator/Reheater Tube Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.455%	0.28	0	0	141.1	1/4
1971	0.202%	0.69	0.17	0	25.8	2/6
1972	0.268%	0.14	0.14	0.14	167.1	2/7
1973	0.071%	0.16	0	0	39.4	2/15
1974	0.040%	0.10	0	0	33.9	2/22
1975	0.039%	0.04	0	0	91.1	1/28
1976	0.008%	0.03	0.03	0	20.2	1/32
1977	0.008%	0.03	0	0	25.0	1/35
1978	0.007%	0.03	0	0	25.0	1/40
TOTAL	0.034%	0.07	0.02	0.01	41.3	7/40

* Hours

Table 2E-15

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Turbine/Generator Lube Oil System Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.017%	0.14	0.14	0	10.5	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.017%	0.13	0	0	11.1	4/32
1977	0.112%	0.11	0.06	0	86.2	4/35
1978	0%	0	0	0	0	0
TOTAL	0.024%	0.05	0.02	0	44.4	8/40

* Hours

Table 2E-16

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = EHC System Electronics Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.004%	0.14	0.14	0.14	2.5	1/7
1973	0.064%	0.24	0.24	0	23.6	3/15
1974	0.008%	0.10	0.10	0	6.7	2/22
1975	0.015%	0.07	0.07	0	17.0	1/28
1976	0.015%	0.13	0.07	0	10.2	4/32
1977	0.009%	0.14	1.11	0	5.8	5/35
1978	0.034%	0.03	0.03	0	114.8	1/40
TOTAL	0.018%	0.09	0.08	0.01	17.0	14/40

* Hours

Table 2E-17

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Spurious Turbine Control/Stop Valve Closure

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0.575%	0.67	0.67	0	75.8	1/3
1969	0.139%	1.00	1.00	0	12.2	1/3
1970	0%	0	0	0.28	0	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0.14	0	1/7
1973	0%	0	0	0	0	0
1974	0.002%	0.10	0.10	0	1.8	1/22
1975	0.014%	0.10	0.15	0.07	6.7	4/28
1976	0.011%	0.07	0.07	0	14.7	2/32
1977	0.001%	0.03	0.03	0.03	3.9	2/35
1978	0.004%	0.05	0	0	6.5	1/40
TOTAL	0.016%	0.09	0.07	0.03	15.9	9/40

* Hours

Table 2E-18

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Turbine/Generator Protection System Malfunctions

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0.004%	0.33	0.33	0	1.1	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.001%	0.52	0.52	0	0.1	1/6
1972	0.025%	0.14	0	0	15.5	1/7
1973	0.028%	0.32	0.32	0	7.8	3/15
1974	0.002%	0.10	0.10	0	1.9	2/22
1975	0.004%	0.11	0.11	0	3.0	3/28
1976	0.036%	0.20	0.20	0	16.1	5/32
1977	0.027%	0.23	0.09	0	10.6	8/35
1978	0.005%	0.08	0.08	0	5.9	2/40
TOTAL	0.015%	0.16	0.13	0	8.4	21/40

* Hours

Table 2E-19

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Turbine/Generator Area Fires

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.024%	0.08	0.08	0.08	27.0	2/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.065%	0.06	0.03	0	100.9	2/35
1978	0%	0	0	0	0	0
TOTAL	0.014%	0.02	0.01	0.01	76.2	4/40

* Hours

Table 2E-20

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Generator Voltage Regulator Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.026%	0.56	0.56	0	4.0	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.001%	0.08	0.08	0	0.6	1/15
1974	0.002%	0.05	0.05	0	2.8	1/22
1975	0.002%	0.04	0.04	0	5.5	1/28
1976	0.037%	0.23	0.23	0	14.2	2/32
1977	0.019%	0.17	0.11	0	10.0	5/35
1978	0.014%	0.15	0.15	0	8.0	2/40
TOTAL	0.013%	0.12	0.11	0	9.3	10/40

* Hours

Table 2E-21

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Generator Breaker/Relay Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.031%	0.28	0.14	0	9.7	2/7
1973	0.042%	0.24	0.24	0	15.4	2/15
1974	0.034%	0.26	0.21	0	11.4	5/22
1975	0.014%	0.07	0.07	0	16.6	2/28
1976	0.005%	0.07	0.07	0	7.4	2/32
1977	0.006%	0.09	0.06	0	6.1	3/35
1978	0%	0	0	0	0	0
TOTAL	0.011%	0.09	0.07	0	11.1	12/40

* Hours

Table 2E-22

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Gland Seal and Extraction Steam System Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0.33	0	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0.56	0	1/4
1971	0.089%	0.17	0	0	45.4	1/6
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.025%	0.07	0	0	33.1	2/32
1977	0.002%	0.03	0	0	5.1	1/35
1978	0.012%	0.05	0	0	20.1	2/4
TOTAL	0.009%	0.03	0	0.02	26.1	7/40

* Hours

Table 2E-23

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Moisture Separator/Reheater Valve Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.102%	0.28	0	0.14	31.7	3/7
1973	0%	0	0	0.24	0	2/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0.07	0	1/28
1976	0%	0	0	0.03	0	1/32
1977	0.019%	0.06	0.03	0	30.1	2/35
1978	0.002%	0.03	0.03	0.05	6.1	2/40
TOTAL	0.008%	0.03	0.01	0.05	25.9	7/40

* Hours

Table 2E-24

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Turbine/Generator Instrumentation Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0.17	0	1/6
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.008%	0.07	0.04	0	9.4	2/28
1976	0.007%	0.10	0.10	0	6.1	3/32
1977	0.014%	0.09	0.06	0.03	14.4	4/35
1978	0%	0	0	0.03	0	1/40
TOTAL	0.005%	0.04	0.03	0.02	10.1	8/40

* Hours

Table 2E-25

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Turbine Control/Stop Valve Position Indicator Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.012%	0.03	0.03	0	31.0	1/32
1977	0.012%	0.11	0.03	0	9.2	2/35
1978	0.004%	0.03	0.03	0	12.9	1/40
TOTAL	0.005%	0.03	0.02	0	13.4	3/40

* Hours

Table 2E-26

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Moisture Separator/Reheater Level Control Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.004%	0.04	0.04	0	9.1	1/28
1976	0.004%	0.03	0.03	0	10.7	1/32
1977	0.006%	0.05	0.05	0	9.0	1/35
1978	0.005%	0.08	0.08	0	6.0	2/40
TOTAL	0.004%	0.04	0.04	0	8.0	4/40

* Hours

Table 2E-27

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Moisture Separator/Reheater Piping Problems/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.005%	0.05	0.05	0	8.8	1/22
1975	0%	0	0	0	0	0
1976	0.004%	0.03	0.03	0	9.8	1/32
1977	0%	0	0	0	0	0
1978	0.015%	0.10	0.08	0.03	12.6	5/40
TOTAL	0.004%	0.03	0.03	0.01	11.5	6/40

* Hours

Table 2E-28

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = EHC Power Supply Malfunctions

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.002%	0.14	0.14	0	1.5	1/7
1973	0.012%	0.08	0.08	0	13.0	1/15
1974	0.006%	0.05	0.05	0	10.0	1/22
1975	0.003%	0.04	0	0	6.3	1/28
1976	0%	0	0	0	0	0
1977	0.003%	0.06	0.03	0	5.2	2/35
1978	0.003%	0.08	0.03	0	3.6	2/40
TOTAL	0.003%	0.04	0.03	0	6.5	6/40

* Hours

Table 2E-29

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Spurious Turbine Control/Stop Valve Opening

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0.14	0	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.007%	0.15	0.15	0	4.0	3/28
1976	0%	0	0	0	0	0
1977	0.010%	0.03	0.03	0	30.0	1/35
1978	0%	0	0	0	0	0
TOTAL	0.003%	0.03	0.03	0.01	9.2	5/40

* Hours

Table 2E-30

CALENDAR YEAR PWR PROBLEM PROFILES

System = Turbine/Generator System

Problem = Turbine Valve Tests

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	6.7	0	2/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0.17	0	1/6
1972	0%	0	0	0.42	0	1/7
1973	0%	0	0	0.08	0	1/15
1974	0%	0	0	0.57	0	1/22
1975	0%	0	0	0.37	0	3/28
1976	0%	0	0	0.20	0	3/32
1977	0%	0	0	0.60	0	12/35
1978	0%	0	0	0.77	0	15/40
TOTAL	0%	0	0	0.54	0	19/40

* Hours

Table 2E-31

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Steam Generator Tube Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	1.444%	0.56	0	0.28	223.7	2/4
1971	0.309%	0.17	0	0	157.7	1/6
1972	1.546%	0.42	0.14	0	320.8	2/7
1973	2.311%	0.32	0	0	639.1	3/15
1974	4.769%	0.21	0	0	2001.9	4/22
1975	0.743%	0.26	0	0	248.5	5/28
1976	2.541%	0.85	0.13	0	262.9	9/32
1977	1.943%	0.54	0.06	0	315.9	7/35
1978	0.753%	0.26	0	0	257.7	8/40
TOTAL	1.734%	0.40	0.04	0.01	385.3	16/40

* Hours

Table 2E-32

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Misc. MSIV Malfunctions/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.035%	0.17	0	0	18.0	1/6
1972	0%	0	0	0	0	0
1973	0.456%	0.48	0	0/08	85.7	4/15
1974	0.360%	0.42	0.31	0	75.6	5/22
1975	0.197%	0.26	0.26	0	65.9	5/28
1976	0.002%	0.03	0	0	4.9	1/32
1977	0.030%	0.03	0.03	0	94.1	1/35
1978	0.013%	0.05	0.03	0	21.9	2/40
TOTAL	0.103%	0.14	0.08	0.01	66.8	13/40

* Hours

Table 2E-33

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Steam Line Modification/Repair

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.304%	0.08	0	0	336.2	1/15
1974	0.465%	0.05	0	0	781.7	1/22
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.042%	0.06	0	0	64.5	1/35
1978	0%	0	0	0.03	0	1/40
TOTAL	0.074%	0.02	0	0.01	311.7	4/40

* Hours

Table 2E-34

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = MSIV Closure, Cause Not Given

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.034%	0.52	0.52	0	5.8	2/6
1972	0.107%	0.28	0.28	0	33.5	2/7
1973	0.553%	0.24	0.24	0.08	203.7	3/15
1974	0.099%	0.37	0.37	0	23.6	4/22
1975	0.038%	0.22	0.22	0	14.9	3/28
1976	0.009%	0.07	0.07	0	12.0	2/32
1977	0%	0	0	0	0	0
1978	0.012%	0.10	0.08	0	10.3	3/40
TOTAL	0.060%	0.14	0.10	0.01	37.6	12/40

* Hours

Table 2E-35

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Steam Line Drain Line Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.173%	0.07	0	0	233.0	2/32
1977	0.012%	0.09	0.03	0	12.4	1/35
1978	0.014%	0.05	0.03	0	23.2	2/40
TOTAL	0.033%	0.04	0.01	0	78.5	5/40

* Hours

Table 2E-36

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = MSIV Solenoid Valve Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.012%	0.14	0.14	0	7.5	1/7
1973	0.415%	0.08	0.08	0	459.0	1/15
1974	0.001%	0.05	0.05	0	1.1	1/22
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.001%	0.03	0.03	0	1.2	1/35
1978	0.014%	0.08	0.08	0.03	16.2	3/40
TOTAL	0.031%	0.04	0.04	0.01	73.9	7/40

* Hours

Table 2E-37

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Steam Leaks at Instrument Taps

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.071%	0.05	0	0	120.0	1/22
1975	0.034%	0.11	0	0	26.9	3/28
1976	0.005%	0.03	0	0	14.3	1/32
1977	0.064%	0.03	0	0	196.2	1/35
1978	0%	0	0	0	0	0
TOTAL	0.024%	0.03	0	0	68.5	5/40

* Hours

Table 2E-38

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Unidentified Secondary System Steam Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.026%	0.14	0	0	16.1	1/7
1973	0.188%	0.24	0.01	0.08	69.4	3/15
1974	0.004%	0.05	0	0	7.5	1/22
1975	0%	0	0	0	0	0
1976	0%	0	0	0.03	0	1/32
1977	0%	0	0	0.03	0	1/35
1978	0.015%	0.03	0	0	52.5	1/40
TOTAL	0.017%	0.03	0.01	0.01	47.4	8/40

* Hours

Table 2E-39

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Steam Generator Manhole Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.163%	0.28	0.28	0	50.4	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.011%	0.04	0	0.04	25.4	2/28
1976	0.020%	0.03	0	0.03	54.1	2/32
1977	0%	0	0	0	0	0
1978	0.042%	0.03	0	0	144.0	1/40
TOTAL	0.016%	0.02	0.01	0.01	68.5	5/40

* Hours

Table 2E-40

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Instrumentation Valve Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.023%	0.07	0	0	27.5	2/28
1976	0%	0	0	0	0	0
1977	0.027%	0.03	0	0	83.2	1/35
1978	0.035%	0.03	0	0.03	118.6	1/40
TOTAL	0.015%	0.02	0	0.01	64.2	3/40

* Hours

Table 2E-41

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Steam Dump Valve Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.162%	0.14	0.14	0	101.1	1/7
1973	0.001%	0.08	0.08	0	1.2	1/15
1974	0%	0	0	0	0	0
1975	0.008%	0.04	0	0	19.3	1/22
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.007%	0.02	0.01	0	40.5	2/40

* Hours

Table 2E-42

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Main Steam Safety Valve Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.001%	0.03	0	0	0.5	1/32
1977	0%	0	0	0	0	0
1978	0.030%	0.03	0.03	0	101.5	1/40
TOTAL	0.006%	0.01	0.01	0	51.0	2/40

* Hours

Table 2E-43

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = MSIV Control Circuitry Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.014%	0.08	0.08	0	16.0	1/15
1974	0%	0	0	0	0	0
1975	0.011%	0.07	0.07	0	12.4	1/28
1976	0%	0	0	0	0	0
1977	0.004%	0.09	0.09	0	4.2	3/35
1978	0.006%	0.03	0.03	0	20.9	1/40
TOTAL	0.004%	0.04	0.04	0	10.6	5/40

* Hours

Table 2E-44

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Instrumentation Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.001%	0.17	0.17	0	0.1	1/6
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.015%	0.10	0.10	0	12.4	2/22
1975	0.003%	0.04	0	0	7.2	1/28
1976	0%	0	0	0	0	0
1977	0.012%	0.03	0.03	0.03	39.6	2/40
1978						
TOTAL	0.004%	0.03	0.02	0.01	14.3	6/40

* Hours

Table 2E-45

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Steam System

Problem = Steam System Tests

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.017%	0.14	0	0	10.5	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0.04	0	1/28
1976	0%	0	0	0	0	0
1977	0%	0	0	0.03	0	1/35
1978	0%	0	0	0.13	0	3/40
TOTAL	0.001%	0.01	0	0.03	10.5	5/40

* Hours

Table 2E-46

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps

Problem = RCP Seal Failures/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0.609%	0.33	0	0	160.4	1/3
1969	0.219%	0.33	0	0	57.6	1/3
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.165%	0.05	0.05	0	277.6	1/22
1975	1.752%	0.49	0.15	0	315.8	8/28
1976	0.615%	0.20	0.03	0	215.9	5/32
1977	0.448%	0.09	0.06	0	460.9	3/35
1978	0.865%	0.26	0	0	296.1	8/40
TOTAL	0.628%	0.18	0.04	0	302.8	17/40

* Hours

Table 2E-47

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps

Problem = RCP Shaft Failure

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.694%	0.08	0.08	0	768.0	1/15
1974	1.282%	0	0	0	2152.0	1/22
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.173%	0.01	0.01	0	2920.0	1/40

* Hours

Table 2E-48

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps

Problem = Unidentified Malfunctions/Repairs

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	1.292%	0.10	0.05	0	1084.7	2/22
1975	0.001%	0.04	0	0	2.5	1/28
1976	0%	0	0	0	0	0
1977	0.003%	0.03	0.03	0	9.4	1/35
1978	0.002%	0.03	0.03	0.03	8.4	2/40
TOTAL	0.129%	0.03	0.02	0.01	437.9	6/40

* Hours

Table 2E-49

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps
 Problem = RCP Lube Oil System Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.032%	0.10	0	0	27.0	2/22
1975	0.406%	0.19	0	0.11	190.4	5/28
1976	0.068%	0.10	0	0.20	60.9	7/32
1977	0.077%	0.17	0	0.14	39.8	7/35
1978	0.040%	0.26	0.03	0.15	13.8	9/40
TOTAL	0.093%	0.14	0.01	0.10	60.2	16/40

* Hours

Table 2E-50

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps
 Problem = RCP Motor Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0.129%	0.33	0	0	34.1	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.459%	0.08	0	0	507.5	1/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.166%	0.03	0	0	447.0	1/32
1977	0.054%	0.03	0	0	168.0	1/35
1978	0%	0	0	0	0	0
TOTAL	0.069%	0.02	0.01	0	289.2	3/40

* Hours

Table 2E-51

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps

Problem = Seal Injection System Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.131%	0.07	0.04	0	153.6	2/28
1976	0%	0	0	0	0	0
1977	0.102%	0.11	0.06	0	78.4	3/35
1978	0.098%	0.05	0	0	168.0	2/40
TOTAL	0.057%	0.04	0.02	0	119.6	5/40

* Hours

Table 2E-52

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps

Problem = Excessive RCP Vibration

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0.14	0	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.113%	0.04	0	0	265.5	1/28
1976	0.006%	0.07	0	0	8.6	2/32
1977	0%	0	0	0	0	0
1978	0.034%	0.03	0	0	118.1	1/40
TOTAL	0.024%	0.02	0	0.01	100.2	5/40

* Hours

Table 2E-53

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps

Problem = Controlled Bleedoff System Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.027%	0.04	0	0	62.9	1/28
1976	0.051%	0.03	0	0	136.0	1/32
1977	0.060%	0.06	0.03	0	92.7	2/35
1978	0%	0	0	0	0	0
TOTAL	0.023%	0.02	0.01	0	96.1	4/40

* Hours

Table 2E-54

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps

Problem = Seal Pressure Sensing Line Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.001%	0.03	0	0	2.7	1/35
1978	0.046%	0.08	0	0	52.1	2/40
TOTAL	0.009%	0.02	0	0	39.8	2/40

* Hours

Table 2E-55

CALENDAR YEAR PWR PROBLEM PROFILES
 System = Reactor Coolant Pumps
 Problem = RCP Heat Exchanger Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	7.9	1/28
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0.038%	0.03	0.03	0	131.8	1/40
TOTAL	0.008%	0.01	0.01	0	69.9	2/40

* Hours

Table 2E-56

CALENDAR YEAR PWR PROBLEM PROFILES
 System = Reactor Coolant Pumps
 Problem = RCP Motor Surge Suppression Capacitor Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.008%	0.03	0.03	0	22.2	1/32
1977	0.010%	0.06	0.06	0	15.0	1/35
1978	0.007%	0.03	0.03	0	25.1	1/40
TOTAL	0.005%	0.02	0.02	0	19.3	2/40

* Hours

Table 2E-57

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps

Problem = RCP Instrumentation Malfunctions

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0.28	0	1/4
1971	0%	0	0	0.17	0	1/6
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.001%	0.04	0.04	0	2.3	1/28
1976	0%	0	0	0.07	0	1/32
1977	0%	0	0	0	0	0
1978	0.013%	0.03	0.03	0.03	43.1	2/40
TOTAL	0.003%	0.01	0.01	0.03	22.7	5/40

* Hours

Table 2E-58

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps

Problem = General Testing and Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0.33	0	1/3
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.008%	0.03	0	0.03	22.4	2/32
1977	0.006%	0.03	0.03	0	18.8	1/35
1978	0%	0	0	0.03	0	1/40
TOTAL	0.002%	0.01	0.01	0.02	20.6	5/40

* Hours

Table 2E-59

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant Pumps

Problem = RCP Seal Vent Line Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.009%	0.03	0	0	28.0	1/35
1978	0%	0	0	0	0	0
TOTAL	0.002%	0.01	0	0	28.0	1/40

*hours

Table 2E-60

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = CEA Repatch/Changeout

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	2.814%	0.17	0	0	1752.0	1/7
1973	2.124%	0.08	0	0	2349.0	1/15
1974	0%	0	0	0	0	0
1975	0.135%	0.04	0	0	315.6	1/28
1976	0.009%	0.03	0	0	25.4	1/32
1977	0%	0	0	0	0	0
1978	0.029%	0.03	0	0	98.9	1/40
TOTAL	0.269%	0.02	0	0	1135.2	4/40

* Hours

Table 2E-61

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = CRDM Housing Seal Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	1.827%	0.85	0	0.28	189.6	1/7
1973	0%	0	0	0	0	0
1974	0.141%	0.05	0	0	237.1	1/22
1975	0.097%	0.04	0	0	227.3	1/28
1976	0.102%	0.07	0.03	0	137.4	1/32
1977	0.133%	0.06	0.03	0	205.3	2/35
1978	0.341%	0.23	0	0	129.7	1/40
TOTAL	0.205%	0.11	0.01	0.01	164.5	2/40

* Hours

Table 2E-62

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = CEA Drop - Control Rod Drive Mechanism Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.148%	0.24	0.08	0.08	54.5	2/15
1974	0.099%	0.10	0	0.05	83.1	2/22
1975	0.293%	0.26	0.07	0	98.1	3/28
1976	0.032%	0.07	0	0	43.2	2/32
1977	0.061%	0.20	0.11	0	26.9	5/35
1978	0.060%	0.10	0	0.05	51.0	4/40
TOTAL	0.089%	0.13	0.04	0.02	59.8	9/40

* Hours

Table 2E-63

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = Control Rod Drive Mechanism Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.010%	0.05	0	0	16.0	1/22
1975	0.026%	0.07	0	0	30.6	2/28
1976	0.142%	0.13	0.07	0	95.4	4/32
1977	0.037%	0.09	0	0	37.8	1/35
1978	0.044%	0.05	0	0	75.0	2/40
TOTAL	0.043%	0.05	0.01	0	80.2	6/40

* Hours

Table 2E-64

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = CEA Drops - Cause Not Identified

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.003%	0.17	0.17	0	1.5	1/6
1972	0.007%	0.14	0.14	0	4.2	1/7
1973	0.001%	0.08	0.08	0.16	1.4	3/15
1974	0.014%	0.10	0.05	0	11.4	2/22
1975	0.038%	0.15	0.11	0	22.5	3/28
1976	0.056%	0.36	0.23	0.10	13.8	7/32
1977	0.071%	0.17	0.06	0.06	36.6	6/35
1978	0.005%	0.03	0.03	0.03	15.6	2/40
TOTAL	0.030%	0.14	0.09	0.05	18.8	17/40

* Hours

Table 2E-65

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = CEA's Inoperable/Various Causes

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.097%	0.17	0	0	60.3	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.132%	0.04	0.04	0	155.2	2/28
1976	0.020%	0.03	0.03	0.03	54.5	2/32
1977	0.015%	0.06	0	0	22.4	1/35
1978	0.012%	0.05	0	0.08	20.4	3/40
TOTAL	0.030%	0.04	0.01	0.02	73.0	6/40

* Hours

Table 2E-66

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = CEA Drops - Faulty Connections

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0.17	0	1/7
1973	0.008%	0.16	0.08	0	4.3	2/15
1974	0%	0	0	0.05	0	1/22
1975	0.091%	0.04	0.04	0	213.7	1/28
1976	0.004%	0.03	0	0	12.0	1/32
1977	0.052%	0.09	0.06	0	53.5	3/35
1978	0%	0	0	0.03	0	1/40
TOTAL	0.023%	0.04	0.02	0.02	56.4	10/40

* Hours

Table 2E-67

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = CEA Drop - Misc. Control Electronics Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0.398%	1.00	0.67	0	35.0	2/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.004%	0.17	0.17	0	2.0	1/6
1972	0.022%	0.28	0.28	0	6.8	2/7
1973	0.004%	0.08	0.08	0	4.0	1/15
1974	0.015%	0.16	0.10	0.10	8.3	3/22
1975	0.045%	0.22	0.15	0	17.6	6/28
1976	0.023%	0.10	0.07	0	20.9	3/32
1977	0.012%	0.11	0.11	0	9.5	4/35
1978	0.003%	0.05	0.05	0	4.6	2/40
TOTAL	0.022%	0.13	0.10	0.01	14.6	16/40

* Hours

Table 2E-68

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = CRDM Cooling System Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.033%	0.05	0.05	0	54.7	1/22
1975	0.067%	0.11	0.04	0	52.0	3/28
1976	0.003%	0.03	0.03	0	9.0	1/32
1977	0%	0	0	0	0	0
1978	0.005%	0.03	0.03	0	17.6	1/40
TOTAL	0.014%	0.03	0.02	0	39.6	6/40

* Hours

Table 2E-69

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = CEA Drops - Power Supply Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0.164%	0.33	0	0	43.1	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.008%	0.17	0.17	0	4.0	1/6
1972	0.007%	0.14	0.14	0	4.5	1/7
1973	0%	0	0	0.08	0	1/15
1974	0.003%	0.05	0.05	0	4.7	1/22
1975	0.018%	0.11	0.11	0	13.9	3/28
1976	0.042%	0.10	0.07	0.03	37.7	2/32
1977	0.005%	0.11	0.11	0	3.9	4/35
1978	0%	0	0	0.10	0	4/40
TOTAL	0.013%	0.07	0.06	0.03	16.2	13/40

* Hours

Table 2E-70

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = CEA Drops - Power Relay Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0.273%	0.33	0.33	0	72.0	1/3
1969	0.521%	1.00	1.00	0	45.7	2/3
1970	0.010%	0.28	0.28	0	3.2	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.005%	0.03	0.03	0.03	13.7	2/32
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.013%	0.03	0.03	0.01	37.7	4/40

* Hours

Table 2E-71

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = General CEA Testing/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.001%	0.08	0.08	0	1.4	1/15
1974	0%	0	0	0	0	0
1975	0.039%	0.04	0	0	91.7	1/28
1976	0.033%	0.03	0.03	0.03	88.8	2/32
1977	0%	0	0	0	0	0
1978	0.002%	0.03	0.03	0.08	5.9	3/40
TOTAL	0.011%	0.02	0.02	0.02	47.0	6/40

* Hours

Table 2E-72

CALENDAR YEAR PWR PROBLEM PROFILES

System = Control Rod System

Problem = Motor Generator System Malfunctions

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.015%	0.17	0.17	0	7.6	1/6
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.017%	0.07	0.07	0	19.4	1/28
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.003%	0.02	0.02	0	15.5	2/40

* Hours

Table 2E-73

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Control Valves - Misc. Problems/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	1.236%	0.28	0.28	0	384.8	1/7
1973	0.203%	0.24	0.16	0	75.0	3/15
1974	0.025%	0.26	0.26	0	8.5	4/22
1975	0.053%	0.19	0.19	0.04	24.7	5/28
1976	0.029%	0.29	0.23	0	8.8	6/32
1977	0.211%	0.14	0.14	0.03	130.7	3/35
1978	0.031%	0.13	0.13	0.03	21.5	6/40
TOTAL	0.119%	0.18	0.11	0.01	58.8	17/40

* Hours

Table 2E-74

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Misc. Feedwater System Piping Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	1.00	0	2/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0.28	0	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.416%	0.16	0.05	0	232.7	3/22
1975	0.101%	0.22	0.04	0.11	39.6	6/28
1976	0.004%	0.03	0	0	9.9	1/32
1977	0.005%	0.03	0.03	0	14.6	1/35
1978	0.111%	0.03	0	0.08	381.0	3/40
TOTAL	0.080%	0.05	0.02	0.05	134.1	14/40

* Hours

Table 2E-75

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Pump Speed Controller Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.011%	0.08	0.08	0	12.0	1/15
1974	0.741%	0.16	0	0	414.7	2/22
1975	0.007%	0.07	0.07	0.04	8.2	1/28
1976	0.018%	0.07	0.07	0.07	24.9	3/32
1977	0.006%	0.09	0.09	0.06	6.3	3/35
1978	0.008%	0.10	0.10	0.08	7.0	4/40
TOTAL	0.079%	0.08	0.06	0.04	89.4	11/40

* hours

Table 2E-76

CALENDAR YEAR PWP PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Control System Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	1.889%	0.38	0.28	0	585.3	1/4
1971	0.025%	0.17	0.17	0	12.8	1/6
1972	0.004%	0.14	0.14	0	2.8	1/7
1973	0.020%	0.32	0.32	0	5.7	3/15
1974	0.006%	0.10	0.10	0	4.9	2/22
1975	0.011%	0.19	0.19	0	5.0	4/28
1976	0.019%	0.10	0.10	0	17.3	3/32
1977	0.016%	0.17	0.17	0	8.3	4/35
1978	0.113%	0.26	0.26	0.03	38.6	6/40
TOTAL	0.069%	0.17	0.17	0.01	35.5	19/40

* Hours

Table 2E-77

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Pump Trips, Cause Not Specified

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.008%	0.28	0.28	0	2.6	1/4
1971	0%	0	0	0	0	0
1972	0.018%	0.28	0.28	0	5.5	2/7
1973	0.252%	0.08	0	0	279.0	1/15
1974	0.196%	0.47	0.42	0	36.6	2/22
1975	0.025%	0.22	0.22	0	9.9	6/28
1976	0.040%	0.33	0.33	0.20	10.8	9/32
1977	0.059%	0.37	0.37	0.14	14.0	9/35
1978	0.032%	0.20	0.15	0	13.6	6/40
TOTAL	0.064%	0.26	0.24	0.06	21.6	22/40

* Hours

Table 2E-78

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Level Trips - Power Level Not Specified

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.055%	1.03	1.03	0	4.7	2/6
1972	0.003%	0.57	0.57	0	0.4	2/7
1973	0.041%	0.32	0.32	0	11.4	2/15
1974	0.173%	1.67	1.67	0	9.1	6/22
1975	0.150%	1.46	1.46	0	9.0	9/28
1976	0.06%	0.88	0.88	0	8.4	5/32
1977	0.007%	0.14	0.14	0	4.0	4/35
1978	0.003%	0.03	0.03	0	9.3	1/40
TOTAL	0.055%	0.61	0.61	0	7.9	14/40

* Hours

Table 2E-79

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Misc. Feedwater System Problems/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0.014%	0.33	0	0	3.6	1/3
1969	0%	0	0	0.33	0	1/3
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0.14	0	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.005%	0.07	0.07	0	5.7	2/28
1976	0.260%	0.20	0.10	0.03	116.4	5/32
1977	0.014%	0.06	0.06	0	21.9	2/35
1978	0.002%	0.03	0.03	0.05	5.6	3/40
TOTAL	0.045%	0.06	0.1	0.03	63.6	11/40

* Hours

Table 2E-80

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Heater Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0.33	0	1/3
1969	0.337%	0.67	0	0	44.3	1/3
1970	0.135%	0.28	0	0.56	41.8	1/4
1971	0.049%	0.17	0.17	0	24.8	1/6
1972	0%	0	0	0	0	0
1973	0%	0	0	0.16	0	1/15
1974	0.012%	0.05	0.05	0	20.5	1/22
1975	0.048%	0.11	0	0	37.3	3/28
1976	0.026%	0.07	0	0.10	34.3	3/32
1977	0.084%	0.20	0	0.06	37.0	6/35
1978	0.018%	0.05	0	0.18	30.9	4/40
TOTAL	0.040%	0.10	0.01	0.09	35.6	13/40

* Hours

Table 2E-81

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Level Trips During Startups

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.004%	0.17	0.17	0	2.2	1/6
1972	0.024%	0.71	0.71	0	2.9	3.7
1973	0.016%	0.63	0.55	0	2.2	4/15
1974	0.024%	0.99	0.99	0	2.1	6/22
1975	0.038%	0.71	0.71	0	4.7	7/28
1976	0.015%	0.42	0.42	0	3.2	7/32
1977	0.034%	0.51	0.51	0	5.8	9/35
1978	0.038%	0.56	0.56	0	5.9	15/40
TOTAL	0.026%	0.55	0.55	0	4.2	24/40

* Hours

Table 2E-82

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater System Check Valve Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0.67	0	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.064%	0.10	0	0	53.5	1/22
1975	0.046%	0.04	0	0	106.9	1/28
1976	0%	0	0	0	0	0
1977	0%	0	0	0.06	0	1/35
1978	0.047%	0.05	0	0	80.7	2/40
TOTAL	0.022%	0.03	0	0.02	75.0	4/40

* Hours

Table 2E-83

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Heater Drain Tank System Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0.28	0	1/4
1971	0.001%	0.17	0.17	0	0.6	1/6
1972	0%	0	0	0.71	0	1/7
1973	0%	0	0	0.08	0	1/15
1974	0.096%	0.16	0.10	0.05	53.8	3/22
1975	0.044%	0.26	0.11	0	14.6	3/28
1976	0%	0	0	0	0	0
1977	0.010%	0.06	0.06	0.06	16.0	2/35
1978	0.012%	0.13	0.10	0	7.9	5/40
TOTAL	0.020%	0.09	0.06	0.05	18.7	11/40

* Hours

Table 2E-84

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Control Valves - Valve Operator Malfunctions

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.051%	0.34	0.34	0	13.1	1/6
1972	0.044%	0.28	0.28	0	13.9	2/7
1973	0.001%	0.08	0.08	0	1.0	1/15
1974	0.007%	0.05	0.05	0	11.0	1/22
1975	0.051%	0.34	0.30	0.04	13.2	7/28
1976	0.003%	0.10	0.10	0.03	3.1	3/32
1977	0.023%	0.17	0.17	0	11.7	5/35
1978	0.017%	0.13	0.13	0.03	11.6	6/40
TOTAL	0.019%	0.15	0.15	0.02	11.1	15/40

* Hours

Table 2E-85

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Misc. Feedwater Pump Problems/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.020%	0.08	0	0.16	22.0	2/15
1974	0.054%	0.21	0.10	0.16	22.5	4/22
1975	0.037%	0.07	0.07	0.04	43.4	3/28
1976	0.011%	0.10	0.10	0.10	10.3	5/32
1977	0%	0	0	0.06	0	1/35
1978	0.010%	0.05	0.05	0.10	17.1	5/40
TOTAL	0.016%	0.06	0.05	0.08	22.0	13/40

* Hours

Table 2E-86

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Control Valve Bypass Valve Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.034%	0.28	0.14	0	10.6	2/7
1973	0.201%	0.16	0.08	0	111.2	2/15
1974	0%	0	0	0	0	0
1975	0.004%	0.11	0.11	0	3.5	1/28
1976	0.005%	0.03	0.03	0	14.0	1/32
1977	0.001%	0.03	0.03	0	2.6	1/35
1978	0.002%	0.03	0.03	0	6.4	1/40
TOTAL	0.016%	0.05	0.03	0	27.7	7/40

* Hours

Table 2E-87

CALENDAR YEAR PWR PROFILE PROBLEMS

System = Main Feedwater System

Problem = Feedwater Control Valves - Valve Malfunctions/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0.067%	0.33	0.33	0	17.7	1/3
1970	0.047%	0.28	0.28	0.28	14.5	2/4
1971	0%	0	0	0.17	0	1/6
1972	0.003%	0.14	0.14	0	1.6	1/7
1973	0%	0	0	0	0	0
1974	0.007%	0.05	0	0.05	11.6	1/22
1975	0.052%	0.19	0.11	0	24.3	4/28
1976	0.011%	0.10	0.03	0	9.9	3/32
1977	0.011%	0.03	0.03	0	34.7	1/35
1978	0.008%	0.03	0	0	27.1	1/40
TOTAL	0.015%	0.07	0.04	0.02	18.5	10/40

* Hours

Table 2E-88

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Heater Drain Tank Pump Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0.28	0	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.002%	0.05	0.05	0.05	2.0	2/22
1975	0.025%	0.11	0.07	0.19	19.2	4/28
1976	0.036%	0.03	0	0.26	98.0	4/32
1977	0.007%	0.06	0.06	0.06	5.6	5/35
1978	0.016%	0.08	0.08	0.41	18.7	11/40
TOTAL	0.014%	0.06	0.05	0.18	19.7	21/40

* Hours

Table 2E-89

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Pump Piping/Instrumentation Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0.28	0	1/4
1971	0%	0	0	0.17	0	1/6
1972	0%	0	0	0	0	0
1973	0%	0	0	0.48	0	1/15
1974	0%	0	0	0	0	0
1975	0.075%	0.15	0.11	0.07	43.9	3/28
1976	0.003%	0.07	0	0.20	4.0	6/32
1977	0.005%	0.09	0.09	0.06	5.3	5/35
1978	0.004%	0.03	0.03	0.08	12.6	4/40
TOTAL	0.013%	0.05	0.04	0.11	21.2	17/40

* Hours

Table 2E-90

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Condensate/Condensate Booster Pump Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.001%	0.08	0.08	0	0.5	1/15
1974	0.009%	0.10	0.10	0.05	7.4	3/22
1975	0.009%	0.08	0.08	0	11.0	2/28
1976	0.009%	0.07	0.07	0	12.0	2/32
1977	0.002%	0.03	0.03	0.20	6.8	3/35
1978	0.019%	0.05	0.05	0.26	32.9	3/40
TOTAL	0.008%	0.05	0.05	0.09	13.3	10/40

* Hours

Table 2E-91

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Pump Mechanical Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0.33	0	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0.28	0	1/4
1971	0%	0	0	0	0	0
1972	0.105%	0.14	0.14	0.14	65.2	2/7
1973	0%	0	0	0.16	0	1/15
1974	0.032%	0.05	0	0.21	54.0	4/22
1975	0.009%	0.07	0.07	0.04	10.1	2/28
1976	0%	0	0	0.13	0	4/32
1977	0%	0	0	0.06	0	2/35
1978	0.001%	0.03	0.03	0.44	3.6	8/40
TOTAL	0.008%	0.03	0.02	0.17	28.6	15/40

* Hours

Table 2E-92

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Misc. Feedwater System Valve Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.067%	0.56	0	0	10.4	1/4
1971	0%	0	0	0	0	0
1972	0.027%	0.14	0	0	16.7	1/7
1973	0.004%	0.08	0	0	4.0	1/15
1974	0.002%	0.05	0	0	3.2	1/22
1975	0.014%	0.11	0	0	10.8	3/28
1976	0%	0	0	0.07	0	1/32
1977	0.007%	0.03	0	0	22.5	1/35
1978	0.006%	0.05	0.03	0.05	10.7	3/40
TOTAL	0.007%	0.06	0.01	0.02	11.0	11/40

* Hours

Table 2E-93

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater System Instrumentation Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.017%	0.28	0	0	5.2	1/4
1971	0%	0	0	0	0	0
1972	0.012%	0.28	0.28	0	3.9	2/7
1973	0.001%	0.08	0.08	0	0.4	1/15
1974	0%	0	0	0	0	0
1975	0.008%	0.07	0.07	0.04	9.2	1/28
1976	0.003%	0.07	0.07	0.03	4.1	3/32
1977	0.011%	0.09	0.03	0	11.5	3/35
1978	0.006%	0.08	0.05	0	6.4	3/40
TOTAL	0.006%	0.07	0.05	0.01	6.7	11/40

* Hours

Table 2E-94

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Pump Lube Oil System Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0.14	0	1/7
1973	0%	0	0	0.24	0	1/15
1974	0.004%	0.10	0.10	0	3.0	2/22
1975	0%	0	0	0.07	0	1/28
1976	0%	0	0	0.07	0	2/32
1977	0.027%	0.14	0.14	0.09	16.4	6/35
1978	0.002%	0.03	0.03	0.05	18.5	3/40
TOTAL	0.006%	0.04	0.04	0.07	12.1	11/40

* Hours

Table 2E-95

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater System Pump Suction Strainer Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0.33	0	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.016%	0.14	0.14	0	9.7	1/7
1973	0.005%	0.08	0	0	5.5	1/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0.07	0	2/28
1976	0%	0	0	0	0	0
1977	0.003%	0.03	0.03	1.39	10.8	2/35
1978	0.009%	0.05	0.05	1.10	16.0	4/40
TOTAL	0.003%	0.03	0.02	0.49	11.6	9/40

* Hours

Table 2E-96

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Isolation Valve Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.001%	0.14	0.14	0	0.9	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.005%	0.03	0.03	0	14.0	1/32
1977	0.005%	0.06	0.06	0.03	8.2	3/35
1978	0.003%	0.03	0	0	11.0	1/40
TOTAL	0.003%	0.03	0.02	0.01	8.5	6/40

* Hours

Table 2E-97

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Heater Level Control Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0.17	0	1/6
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0.05	0	1/22
1975	0.010%	0.07	0.07	0	11.7	1/28
1976	0%	0	0	0.03	0	1/32
1977	0.002%	0.03	0.03	0	5.4	1/35
1978	0.007%	0.03	0.03	0	24.1	1/40
TOTAL	0.003%	0.02	0.02	0.02	13.2	6/40

* Hours

Table 2E-98

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Pump Seal/Packing Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0.111%	0.33	0	0	29.2	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0.14	0	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0.05	0	2/40
TOTAL	0.002%	0.01	0	0.02	29.2	3/40

* Hours

Table 2E-99

CALENDAR YEAR PWR PROBLEM PROFILES

System = Main Feedwater System

Problem = Feedwater Pump Recirculation Valve Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.002%	0.03	0.03	0	5.2	1/35
1978	0%	0	0	0	0	0
TOTAL	0.001%	0.01	0.01	0	5.2	1/40

* Hours

Table 2E-100

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = Pressurizer Safety/Relief Valve Leakage or Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0.364%	0.33	0	0	85.9	1/3
1969	1.709%	0.67	0	0	224.6	1/3
1970	0.108%	0.56	0	0	16.7	1/4
1971	0%	0	0	0	0	0
1972	0.230%	0.28	0	0	71.5	2/7
1973	0.059%	0.08	0	0	65.1	1/15
1974	0.143%	0.05	0	0.05	239.5	2/22
1975	0.561%	0.11	0	0	438.0	3/28
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0.133%	0.05	0	0	228.2	1/40
TOTAL	0.162%	0.07	0	0.01	195.3	7/40

* Hours

Table 2E-101

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = Leakage from Misc. RCS Valves

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.030%	0.28	0	0.28	9.3	2/4
1971	0.094%	0.17	0	0.34	48.0	2/6
1972	0%	0	0	0	0	0
1973	0.157%	0.16	0	0	86.9	1/15
1974	0.082%	0.10	0	0	68.9	2/22
1975	0.514%	0.37	0.04	0	120.3	6/28
1976	0.048%	0.06	0	0.03	64.6	3/32
1977	0.072%	0.20	0	0	31.7	7/35
1978	0.081%	0.13	0	0	55.1	4/40
TOTAL	0.130%	0.15	0.01	0.02	78.5	16/40

* Hours

Table 2E-102

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = Pressurizer Spray Valve Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0.277%	0.33	0	0	73.0	1/3
1969	0%	0	0	0	0	0
1970	0.125%	0.28	0	0.28	38.7	2/4
1971	0.053%	0.34	0.17	0.17	13.6	1/6
1972	0.232%	0.71	0	0	28.9	3/7
1973	0.085%	0.08	0	0	94.0	1/15
1974	0.311%	0.21	0.05	0	130.7	2/22
1975	0.043%	0.15	0.04	0	25.4	3/28
1976	0%	0	0	0	0	0
1977	0.163%	0.26	0	0	55.9	5/35
1978	0.101%	0.15	0.05	0.03	57.4	4/40
TOTAL	0.110%	0.17	0.03	0.01	56.0	16/40

* Hours

Table 2E-103

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = Misc. Maintenance and Testing

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0.28	0	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0.16	0	2/15
1974	0.103%	0.05	0	0	172.7	1/22
1975	0.001%	0.04	0.04	0.04	3.0	2/28
1976	0	0	0	0	0	0
1977	0.012%	0.03	0	0.03	36.4	2/35
1978	0.140%	0.05	0	0.08	239.8	3/40
TOTAL	0.041%	0.03	0.01	0.04	138.3	11/40

* Hours

Table 2E-104

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = Pressurizer Manway Gasket Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.310%	0.28	0.28	0	96.0	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.083%	0.05	0	0	139.5	1/22
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.017%	0.03	0	0	53.3	1/35
1978	0.112%	0.08	0	0	128.2	2/40
TOTAL	0.040%	0.05	0.01	0	74.8	5/40

* Hours

Table 2E-105

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = Loop Isolation Valve Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.210%	0.28	0	0	65.0	1/4
1971	0%	0	0	0.17	0	1/6
1972	0%	0	0	0.14	0	1/7
1973	0%	0	0	0	0	0
1974	0.011%	0.05	0.05	0	17.9	1/22
1975	0.247%	0.07	0.07	0	290.0	2/28
1976	0.004%	0.03	0	0	11.0	1/32
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.040%	0.03	0.02	0.01	168.5	5/40

* Hours

Table 2E-106

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = Blown Rupture Disc On Quench Tank

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.110%	0.05	0	0	184.0	1/22
1975	0%	0	0	0	0	0
1976	0.065%	0.03	0	0	174.3	1/32
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.021%	0.01	0	0	179.2	2/40

* Hours

Table 2E-107

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = Unidentified RCS Leakage

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.006%	0.05	0	0	10.1	1/22
1975	0.035%	0.15	0	0	20.4	1/28
1976	0.041%	0.07	0	0	55.8	2/32
1977	0.021%	0.03	0	0	63.5	1/35
1978	0.011%	0.08	0	0.03	12.2	4/40
TOTAL	0.018%	0.06	0	0.01	27.6	8/40

* Hours

Table 2E-108

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = Misc. Instrumentation Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0.33	0	1/3
1969	0%	0	0	0	0	0
1970	0.025%	0.28	0	0	7.8	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.001%	0.10	0.10	0	1.0	1/22
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.035%	0.11	0.06	0	27.3	4/35
1978	0.047%	0.10	0.08	0.03	40.1	4/40
TOTAL	0.017%	0.06	0.04	0.01	25.4	11/40

* Hours

Table 2E-109

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = Instrumentation Valve Leakage

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0.226%	0.33	0	0	59.5	1/3
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.005%	0.05	0	0	8.4	1/22
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.011%	0.03	0	0	33.2	1/35
1978	0.050%	0.03	0	0.03	171.2	1/40
TOTAL	0.016%	0.02	0	0.01	69.1	4/40

* Hours

Table 2E-110

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = RTD Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0.16	0	1/22
1975	0.049%	0.04	0.04	0	114.3	1/28
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.007%	0.01	0.01	0.02	114.3	2/40

* Hours

Table 2E-111

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Coolant System

Problem = Return Isolated Loop to Service

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.012%	0.28	0	0	3.8	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.032%	0.08	0	0	35.0	1/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0.002%	0.03	0	0	6.3	1/40
TOTAL	0.003%	0.02	0	0	15.0	2/40

* Hours

Table 2E-112

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Vessel Internals

Problem = Reactor Vessel Specimen Holder Tube Failure

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	9.491%	0.16	0	0	1877.9	5/32
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.557%	0.03	0	0	1877.9	5/40

* Hours

Table 2E-113

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Vessel Internals

Problem = Core Support Barrel Flange Wear

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.820%	0.08	0	0	907.0	1/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.054%	0.01	0	0	907.0	1/40

* Hours

Table 2E-114

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Core/Fuel

Problem = Burnable Poison Pins Damaged

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	2.011%	0.05	0.05	0.03	3442.4	2/40
TOTAL	0.408%	0.01	0.01	0.01	3442.4	2/40

* Hours

Table 2E-115

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Core/Fuel

Problem = Fuel Inspection for Densification

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	1.497%	0.05	0	0	2513.0	1/22
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.149%	0.01	0	0	2513.0	1/40

* Hours

Table 2E-116

CALENDAR YEAR PWR PROBLEM PROFILES

System = Reactor Core/Fuel

Problem = Core Physics Tests

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.040%	0.16	0.05	0.05	22.9	2/22
1975	0.023%	0.04	0	0.11	54.9	3/28
1976	0%	0	0	0	0	0
1977	0.058%	0.06	0	0	89.3	2/35
1978	0.045%	0.05	0	0.10	77.8	5/40
TOTAL	0.027%	0.04	0.01	0.05	57.2	11/40

* Hours

Table 2E-117

CALENDAR YEAR PWR PROBLEM PROFILES

System = On-Site Power Systems

Problem = Cable Fires

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	17.561%	0.67	0.67	0	2313.9	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.274%	0.01	0.01	0	2313.9	1/40

* Hours

Table 2E-118

CALENDAR YEAR PWR PROBLEM PROFILES

System = On-Site Power Systems

Problem = Non-Vital/Instrument Bus Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0.018%	0.33	0.33	0	4.8	1/3
1970	0%	0	0	0	0	0
1971	2.223%	0.34	0.34	0	567.2	2/6
1972	0.038%	0.28	0.28	0	11.9	2/7
1973	0%	0	0	0	0	0
1974	0.027%	0.47	0.42	0.05	5.0	6/22
1975	0.057%	0.07	0	0	66.2	1/28
1976	0.034%	0.29	0.26	0	10.3	7/32
1977	0.006%	0.09	0.09	0	6.7	2/35
1978	0.020%	0.10	0.08	0	17.4	3/40
TOTAL	0.091%	0.17	0.14	0.01	47.7	17/40

* Hours

Table 2E-119

CALENDAR YEAR PWR PROBLEM PROFILES

System = On-Site Power Systems

Problem = General Maintenance and Tests

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.126%	0.08	0	0	139.2	1/15
1974	0%	0	0	0	0	0
1975	0.101%	0.04	0	0	235.9	1/28
1976	0%	0	0	0	0	0
1977	0.103%	0.03	0	0	318.5	1/35
1978	0.001%	0.03	0	0	0.3	1/40
TOTAL	0.041%	0.02	0	0	173.5	3/40

* Hours

Table 2E-120

CALENDAR YEAR PWR PROBLEM PROFILES

System = On-Site Power Systems

Problem = Circuit Breaker/Switch Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0.055%	0.67	0.67	0	7.3	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.002%	0.14	0.14	0	1.5	1/7
1973	0.060%	0.48	0.40	0	11.1	4/15
1974	0.008%	0.05	0.05	0	12.8	1/22
1975	0.001%	0.04	0.04	0	0.8	1/28
1976	0.104%	0.07	0.07	0	140.5	2/32
1977	0.003%	0.06	0.06	0	4.4	2/35
1978	0.029%	0.13	0.13	0	19.5	5/40
TOTAL	0.029%	0.10	0.09	0	25.5	12/40

* Hours

Table 2E-121

CALENDAR YEAR PWP PROBLEM PROFILES

System = On-Site Power Systems

Problem = Non-Vital Bus Invertor/Power Supply Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0 018%	0 28	0 28	0	5 7	1/4
1971	0%	0	0	0	0	0
1972	0 019%	0 14	0	0	11 6	1/7
1973	0 005%	0 16	0 16	0 08	2 9	3/15
1974	0 022%	0 26	0 26	0	7 2	4/22
1975	0 014%	0 11	0 11	0	10 6	3/28
1976	0 011%	0 07	0 07	0	14 6	1/32
1977	0 010%	0 11	0 11	0	7 7	4/35
1978	0 040%	0 05	0 05	0	68 7	2/40
TOTAL	0 017%	0 10	0 10	0 01	14 4	12/40

* Hours

Table 2E-122

CALENDAR YEAR PWR PROBLEM PROFILES

System = On-Site Power Systems

Problem = Vital Bus Invertor/Power Supply Failures

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	1 00	0	2/-
1969	0%	0	0	0 67	0	1/3
1970	0%	0	0	0	0	0
1971	0 008%	0 17	0 17	0 17	4 3	2/6
1972	0 006%	0 14	0 14	0 14	3 5	2/7
1973	0 009%	0 16	0 16	0 08	5 2	2/15
1974	0 019%	0 10	0 10	0	15 9	2/22
1975	0%	0	0	0	0	0
1976	0 004%	0 07	0 07	0	5 7	2/32
1977	0 017%	0 17	0 17	0 03	8 5	5/35
1978	0 044%	0 20	0 18	0	18 9	3/40
TOTAL	0 016%	0 11	0 11	0 04	12 0	11/40

* Hours

Table 2E-123

CALENDAR YEAR PWR PROBLEM PROFILES

System = On-Site Power Systems

Problem = Voltage/Frequency Fluctuations On Bus

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.013%	0.55	0.48	0	2.0	4/15
1974	0.008%	0.16	0.16	0	4.2	2/22
1975	0.004%	0.04	0.04	0	9.0	1/28
1976	0%	0	0	0	5.7	0
1977	0.005%	0.03	0.03	0	15.8	1/35
1978	0.043%	0.15	0.15	0	24.3	5/40
TOTAL	0.012%	0.04	0.08	0	11.6	12/40

* Hours

Table 2E-124

CALENDAR YEAR PWR PROBLEM PROFILES

System = On-Site Power Systems

Problem = Transformer Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0.85	0	1/4
1971	0%	0	0	0	0	0
1972	0.137%	0.14	0.14	0	85.3	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.006%	0.04	0.04	0	14.0	1/28
1976	0.023%	0.07	0.03	0	31.2	2/32
1977	0%	0	0	0	0	0
1978	0.010%	0.03	0	0	35.2	1/40
TOTAL	0.012%	0.03	0.02	0.02	39.4	5/40

* Hours

Table 2E-125

CALENDAR YEAR PWR PROBLEM PROFILES

System = On-Site Power Systems

Problem = Vital Bus Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0 67	0	1/3
1970	0%	0	0	0	0	0
1971	0 036%	0 34	0 34	0 17	9 3	1/6
1972	0 021%	0 14	0 14	0	13 1	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0 007%	0 07	0 07	0	6 1	2/28
1976	0 022%	0 13	0 13	0 03	14 9	4/32
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0 006%	0 05	0 05	0 02	11 0	7/40

* Hours

Table 2E-126

CALENDAR YEAR PWR PROBLEM PROFILES

System = On-Site Power Systems

Problem = Battery System Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0.018%	0 33	0 33	0	4 8	1/3
1970	0 004%	0 28	0 28	0	1 3	1/4
1971	0 001%	0 17	0 17	0	0 3	1/6
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0 006%	0 03	0 03	0	19 0	1/35
1978	0%	0	0	0	0	0
TOTAL	0 002%	0 02	0 02	0	6 4	3/40

* Hours

Table 2E-127

CALENDAR YEAR PWR PROBLEM PROFILES

System = On-Site Power Systems

Problem = Motor Control Center Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.001%	0.03	0.03	0	3.2	1/35
1978	0.004%	0.03	0.03	0	15.1	1/40
TOTAL	0.001%	0.01	0.01	0	9.2	2/40

* Hours

Table 2E-128

CALENDAR YEAR PWR PROBLEM PROFILES

System = Condenser System

Problem = Condenser Tube Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	1.33	0	1/3
1969	0%	0	0	1.00	0	2/3
1970	0%	0	0	0.28	0	1/4
1971	0.034%	0.17	0	1.37	17.2	3/6
1972	0.017%	0.14	0	0.99	10.3	3/7
1973	0.028%	0.08	0	0.24	31.0	3/15
1974	0.988%	0.37	0	0.52	236.9	4/22
1975	1.197%	0.41	0.07	0.45	254.9	9/28
1976	0.075%	0.10	0	1.21	67.6	12/32
1977	0.508%	0.14	0.03	0.51	314.1	11/35
1978	0.061%	0.13	0.03	1.74	41.6	13/40
TOTAL	0.385%	0.18	0.02	0.89	191.2	27/40

* Hours

Table 2E-129

CALENDAR YEAR PWR PROBLEM PROFILES

System = Condenser System

Problem = Misc Condenser Piping Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.075%	0.03	0	0	231.1	1/35
1978	0.018%	0.03	0	0	60.2	1/40
TOTAL	0.017%	0.01	0	0	145.7	2/40

* Hours

Table 2E-130

CALENDAR YEAR PWR PROBLEM PROFILES

System = Condenser System

Problem = Loss of Condenser Vacuum (Misc Causes)

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	<0.001%	0.028	0	0	0.1	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0.05	0	1/22
1975	0.006%	0.01	0.04	0.04	6.7	3/28
1976	0.071%	0.13	0.07	0.03	47.6	5/32
1977	0.002%	0.06	0.03	0	3.4	2/35
1978	0.014%	0.05	0.05	0.01	23.2	2/40
TOTAL	0.015%	0.05	0.03	0.02	23.3	11/40

* hours

Table 2E-131

CALENDAR YEAR PWR PROBLEM PROFILES

System = Condenser System

Problem = Condenser Tests and Unspecified Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	1.00	0	1/3
1969	0%	0	0	0.33	0	1/3
1970	0%	0	0	0.28	0	1/4
1971	0%	0	0	0.17	0	1/6
1972	0%	0	0	0.28	0	1/7
1973	0%	0	0	0	0	0
1974	0.005%	0.05	0.05	0.16	8.0	2/22
1975	0.063%	0.15	0	0.04	37.1	3/28
1976	0%	0	0	0	0	0
1977	0%	0	0	0.06	0	2/35
1978	0%	0	0	0.44	0	4/35
TOTAL	0.009%	0.03	0.01	0.16	31.3	12/40

* Hours

Table 2E-132

CALENDAR YEAR PROBLEM PROFILES

System = Condenser System

Problem = Condenser Cleaning/Backwashing

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	2.67	0	2/3
1969	0%	0	0	1.00	0	1/3
1970	0%	0	0	0.28	0	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0.28	0	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0.07	0	1/32
1977	0.023%	0.06	0	0.14	35.7	7/35
1978	0%	0	0	0.28	0	6/40
TOTAL	0.004%	0.01	0	0.17	35.7	12/40

* Hours

Table 2E-133

CALENDAR YEAR PWR PROBLEM PROFILES

System = Condenser System

Problem = Air Ejector System Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0.28	0	1/7
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.003%	0.04	0.04	0	6.0	1/20
1976	0%	0	0	0.03	0	1/32
1977	0%	0	0	0	0	0
1978	0.002%	0.03	0.03	0	7.8	1/40
TOTAL	0.001%	0.01	0.01	0.03	6.9	3/40

* Hours

Table 2E-134

CALENDAR YEAR PWR PROBLEM PROFILES

System = Condenser System

Problem = Hotwell Pump Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0.03	0	1/32
1977	<0.001%	0.03	0.03	0	1.2	1/35
1978	0%	0	0	0	0	0
TOTAL	<0.001%	0.01	0.01	0.01	1.2	2/40

* Hours

Table 2E-135

CALENDAR YEAR PWR PROBLEM PROFILES

System = Condenser System
 Problem = Vacuum Pump Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0.33	0	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	<0.001%	0.03	0.03	0	0.1	1/35
1978	0%	0	0	0	0	0
TOTAL	<0.001%	0.01	0.01	0.01	0.1	2/40

* Hours

Table 2E-136

CALENDAR YEAR PWR PROBLEM PROFILES

System = Electrical Distribution System
 Problem = Main Transformer Failures/Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0.063%	0.17	0	0	32.0	1/6
1972	0.430%	0.14	0	0	267.5	1/7
1973	0.105%	0.08	0	0	116.3	1/15
1974	0%	0	0	0.05	0.	1/22
1975	0.002%	0.07	0	0	2.2	2/28
1976	0%	0	0	0	0	0
1977	0.092%	0.07	0.07	0	141.4	2/35
1978	1.115%	0.15	0.08	0.03	636.2	5/40
TOTAL	0.268%	0.07	0.03	0.01	347.7	7/40

* Hours

Table 2E-137

CALENDAR YEAR PWR PROBLEM PROFILES

System = Electrical Distribution System

Problem = Switchyard Relay/Breaker Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0.013%	0.33	0.33	0	3.3	1/3
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0.031%	0.14	0.14	0	19.0	1/7
1973	0%	0	0	0	0	0
1974	0.011%	0.10	0.10	0	9.5	1/22
1975	0.016%	0.07	0	0	19.1	2/28
1976	0.277%	0.13	0.10	0	186.5	3/32
1977	0.015%	0.06	0.06	0.03	23.0	3/35
1978	0%	0	0	0.03	0	1/40
TOTAL	0.052%	0.06	0.05	0.01	72.6	8/40

* Hours

Table 2E-138

CALENDAR YEAR PWR PROBLEM PROFILES

System = Electrical Distribution System

Problem = Tie-in Temporary/Permanent Main Transformer

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.001%	0.03	0	0	3.9	1/35
1978	0.039%	0.10	0	0	33.1	3/40
TOTAL	0.008%	0.03	0	0	27.3	4/40

* Hours

Table 2E-139

CALENDAR YEAR PWR PROBLEM PROFILES

System = Electrical Distribution System

Problem = Stepup Transformer Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.001%	0.03	0	0	2.9	1/35
1978	0.021%	0.03	0.03	0	73.6	1/40
TOTAL	0.005%	0.01	0.01	0	38.3	2/40

* Hours

Table 2E-140

CALENDAR YEAR PWR PROBLEM PROFILES

System = Electrical Distribution System

Problem = Switchyard/Transmission Line Malfunctions or Maintenance

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	2.33	0	1/3
1969	0%	0	0	5.00	0	2/3
1970	0.229%	0.28	0	0.56	71.0	2/4
1971	0%	0	0	0.17	0	1/6
1972	0%	0	0	0	0	0
1973	0.004%	0.16	0.16	0	2.1	2/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0.13	0	2/32
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.004%	0.02	0.01	0.15	25.0	6/40

* Hours

Table 2E-141

CALENDAR YEAR PWR PROBLEM PROFILES

System = Electrical Distribution System

Problem = Main Transformer Relay Malfunctions

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.011%	0.07	0.07	0	16.7	2/35
1978	0.003%	0.03	0.03	0	11.3	1/40
TOTAL	0.003%	0.02	0.02	0	14.9	2/40

* Hours

Table 2E-142

CALENDAR YEAR PWR PROBLEM PROFILES

System = Electrical Distribution System

Problem = Main Transformer Lightning Arrestor Malfunctions

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.016%	0.08	0.08	0	18.0	1/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.010%	0.03	0.03	0	27.3	1/32
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.003%	0.01	0.01	0	22.7	2/40

* Hours

Table 2E-143

CALENDAR YEAR PWR PROBLEM PROFILES

System = Electrical Distribution System

Problem = Main Transformer Cooling System Faults

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.007%	0.04	0	0.04	16.3	2/28
1976	0%	0	0	0	0	0
1977	0%	0	0	0.03	0	1/35
1978	0.001%	0.03	0.03	0	5.1	1/40
TOTAL	0.001%	0.07	0.03	0.07	10.7	3/40

* Hours

Table 2E-144

CALENDAR YEAR PWR PROBLEM PROFILES

System = Engineered Safety Features System

Problem = Safety Injection Pump Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0.198%	0.05	0	0	338.9	2/40
TOTAL	0.040%	0.01	0	0	338.9	2/40

* Hours

Table 2E-145

CALENDAR YEAR PWR PROBLEM PROFILES

System = Engineered Safety Features System

Problem = Safety Injection System Piping Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.190%	0.03	0	0	511.0	1/32
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.030%	0.01	0	0	511.0	1/40

* Hours

Table 2E-146

CALENDAR YEAR PWR PROBLEM PROFILES

System = Engineered Safety Features Systems

Problem = Safety Injection System Heat Tracing Malfunction

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0.03	0	1/40
TOTAL	0%	0	0	0.01	0	1/40

* Hours

Table 2E-147

CALENDAR YEAR PWR PROBLEM PROFILES

System = Engineered Safety Features System

Problem = Safety Injection Tank Check Valve Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0.016%	0.05	0	0.05	28.2	2/22
1975	0.040%	0.07	0	0.07	46.4	2/28
1976	0.065%	0.03	0	0	173.9	1/32
1977	0%	0	0	0	0	0
1978	0.006%	0.03	0	0	20.7	1/40
TOTAL	0.019%	0.03	0	0.01	63.1	6/40

* Hours

Table 2E-148

CALENDAR YEAR PWR PROBLEM PROFILES

System = Engineered Safety Features System

Problem = Malfunction of ESF Actuating Device (Relays/Solenoids/Circuit Breakers)

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0.048%	0.28	0.28	0	14.9	1/4
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.016%	0.16	0.16	0	8.8	2/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0.011%	0.05	0.03	0.03	19.1	3/40
TOTAL	0.004%	0.03	0.02	0.01	14.1	5/40

* Hours

Table 2E-149

CALENDAR YEAR PWR PROBLEM PROFILES

System = Engineered Safety Features System

Problem = Safety Injection System Valve Problems

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.054%	0.03	0	0	147.3	1/32
1977	0.054%	0.06	0	0	83.3	2/35
1978	0.066%	0.08	0	0.03	74.9	2/40
TOTAL	0.032%	0.03	0	0.01	89.8	4/40

* Hours

Table 2E-150

CALENDAR YEAR PWR PROBLEM PROFILES

System = Engineered Safety Features System

Problem = ESF Tests

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0.03	0	1/35
1978	0.007%	0.05	0	0.05	11.6	4/40
TOTAL	0.001%	0.01	0	0.02	11.6	5/40

* Hours

Table 2E-151

CALENDAR YEAR PWP PROBLEM PROFILES

System = Engineered Safety Features System

Problem = Safety Injection Tank Nitrogen Supply Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0.012%	0.05	0	0	20.1	1/40
TOTAL	0.002%	0.01	0	0	20.1	1/40

* Hours

Table 2E-152

CALENDAR YEAR PWR PROBLEM PROFILES

System = Chemical and Volume Control System

Problem = CVCS Piping Modification

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	1.607%	0.14	0	0	1000.3	1/7
1973	0	0	0	0	0	0
1974	0	0	0	0	0	0
1975	0	0	0	0	0	0
1976	0	0	0	0	0	0
1977	0	0	0	0	0	0
1978	0	0	0	0	0	0
TOTAL	0.059%	0.01	0	0	1000.3	1/40

* Hours

Table 2E-153

CALENDAR YEAR PWR PROBLEM PROFILES

System = Chemical and Volume Control System

Problem = Volume Control Tank Boron Concentration Anomalies

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.003%	0.04	0.04	0	8.1	1/28
1976	0%	0	0	0.03	0	1/32
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	<0.001%	0.01	0.01	0.01	8.1	2/40

* Hours

Table 2E-154

CALENDAR YEAR PWR PROBLEM PROFILES

System = Chemical and Volume Control System

Problem = Repair of Misc. CVCS Valves

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.090%	0.08	0	0	99.3	1/15
1974	0%	0	0	0	0	0
1975	0.044%	0.04	0	0	104.2	1/28
1976	0%	0	0	0	0	0
1977	0.040%	0.06	0.03	0.03	61.4	3/35
1978	0.021%	0.03	0	0.03	72.0	1/40
TOTAL	0.024%	0.03	0.01	0.01	79.7	5/40

* Hours

Table 2E-155

CALENDAR YEAR PWR PROBLEM PROFILES

System = Chemical and Volume Control System

Problem = Letdown Valve Packing Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0.638%	0.33	0	0	168.0	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0.017%	0.04	0.04	0	39.0	1/28
1976	0%	0	0	0	0	0
1977	0.020%	0.06	0	0	30.9	1/35
1978	0.010%	0.05	0	0	16.3	2/40
TOTAL	0.018%	0.03	0.01	0	50.2	5/40

* Hours

Table 2E-156

CALENDAR YEAR PWR PROBLEM PROFILES

System = Chemical and Volume Control System

Problem = Regenerative Heat Exchanger Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0.062%	0.03	0	0	166.1	1/32
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.010%	0.01	0	0	166.1	1/40

* Hours

Table 2E-157

CALENDAR YEAR PWR PROBLEM PROFILES

System = Chemical and Volume Control System

Problem = CVCS Piping Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0.33	0	1/3
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.036%	0.03	0	0	109.8	1/35
1978	0%	0	0	0	0	0
TOTAL	0.007%	0.01	0	0.001	109.8	2/40

* Hours

Table 2E-158

CALENDAR YEAR PWR PROBLEM PROFILES

System = Chemical and Volume Control System

Problem = Charging Line Check Valve Repair

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.071%	0.08	0.08	0	79.0	1/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.005%	0.01	0.01	0	79.0	1/40

* Hours

Table 2E-159

CALENDAR YEAR PWR PROBLEM PROFILES

System = Chemical and Volume Control System

Problem = Letdown Temperature Control Valve Malfunctions

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0.025%	0.03	0	0	77.4	1/35
1978	0%	0	0	0	0	0
TOTAL	0.005%	0.01	0	0	77.4	1/40

* Hours

Table 2E-160

CALENDAR YEAR PWR PROBLEM PROFILES

System = Chemical and Volume Control System

Problem = CVCS Relief Valve Leaks

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration *	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0%	0	0	0	0	0
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0.006%	0.03	0.03	0	22.0	1/40
TOTAL	0.001%	0.01	0.01	0	22.0	1/40

* Hours

Table 2E-16i

CALENDAR YEAR PWR PROBLEM PROFILES

System = Chemical and Volume Control System

Problem = Auxiliary Pressurizer Spray Valve Malfunction

Year	Average Annual Unavailability Contribution	Total Shutdowns Per Plant Year	Scrams Per Plant Year	Power Reductions Per Plant Year	Average Shutdown Duration*	Fraction of Plants Affected
1968	0%	0	0	0	0	0
1969	0%	0	0	0	0	0
1970	0%	0	0	0	0	0
1971	0%	0	0	0	0	0
1972	0%	0	0	0	0	0
1973	0.010%	0.08	0.08	0	11.0	1/15
1974	0%	0	0	0	0	0
1975	0%	0	0	0	0	0
1976	0%	0	0	0	0	0
1977	0%	0	0	0	0	0
1978	0%	0	0	0	0	0
TOTAL	0.001%	0.01	0.01	0	11.0	1/40

* Hours

APPENDIX 2F

Commercial Year PWR Problem Profiles
Data Tables

APPENDIX 2F

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TABLE 2F-1

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine Blade Failure

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	3.79%	.21	.079	0	1578.7	5/38
2	3.15%	.12	.09	0	2278.1	4/33
3	.58%	.033	0	0	1576.3	1/30
4	1.38%	.08	.04	0	1510.3	2/25
5	0	0	0	0	0	0
6	3.95%	.2	0	0	1731.5	2/10
7	3.40	.428	.142	0	696.5	3/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-2

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Misc. Turbine/Generator Maintenance Problems

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	1.38%	.42	.105	.105	288.7	14/38
2	.74%	.272	.151	0	239.0	6/33
3	.14%	.066	.10	0	179.8	5/30
4	.23%	.44	.04	.04	49.9	9/25
5	.10	.176	0	.059	48.7	4/17
6	4.27%	.30	0	.10	1247.1	2/10
7	.16%	.28	0	0	49.4	2/7
8	0	0	0	.20	0	1/5
9	.02%	.333	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-3

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine Bearing Failure/Maintenance

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.88%	.105	.105	0	728.25	2/38
2	.25%	.06	.06	0	357.15	2/33
3	.10%	.10	0	.10	86.4	3/30
4	.43%	.08	.04	0	471.9	2/25
5	.09%	.176	.118	0	4.5	3/17
6	.41%	.10	0	.10	366.0	2/10
7	0	0	0	.14	0	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-4

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = General Turbine Control/Stop Valve Malfunctions/Maintenance

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.78%	.447	.131	.131	144.9	13/38
2	.29%	.363	.121	.03	71.6	12/33
3	.09%	.266	.10	0	29.3	7/30
4	.01	.20	.08	0	5.6	4/25
5	.03%	.117	0	.117	19.7	3/17
6	0	0	0	.10	0	1/10
7	.18%	.143	.143	.428	114.4	2/7
8	0	0	0	0	0	0
9	.01%	.333	0	0	2.9	1/2
10	.03%	.333	.333	0	6.5	1/3
11	0	0	0	0	0	0

TABLE 2F-5

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Generator Stator Winding Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	.07%	.03	.03	0	206.9	1/33
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	8.81%	.33	0	0	2318.4	1/3

TABLE 2F-6

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine/Generator Inspections and Tests

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.31	.526	.237	.21	51.4	13/38
2	.47%	.272	.09	.06	151.7	17/33
3	.01%	.20	.033	.033	3.7	5/30
4	.02%	.24	.04	0	8.7	5/25
5	.02%	.176	.059	0	8.7	3/17
6	.04%	.10	.10	0	33.7	1/10
7	.01%	.143	0	0	5.2	1/7
8	.09%	.40	0	.20	37.7	2/5
9	0	0	0	0	0	0
10	.03%	.666	0	0	3.8	2/3
11	.02%	.666	0	0	2.7	2/3

TABLE 2F-7

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = General MSR Maintenance

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.27%	.157	.03	0	150.9	4/38
2	.12%	.06	.03	0	168.6	3/33
3	.04%	.066	0	0	46.9	2/30
4	0	0	0	.04	0	1/25
5	0	0	0	.059	0	1/17
6	.05	.10	0	.10	47.0	2/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	.14%	.33	0	0	36.7	1/3
10	0	0	0	0	0	0
11	.40%	.33	0	0	106.5	1/3

TABLE 2F-8

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = EHC Auto-Stop Oil/Fluid System Malfunction

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.25%	.657	.42	.079	34.19	14/38
2	.04%	.333	.182	.03	10.89	9/33
3	.04	.233	.10	.033	16.45	6/30
4	.023%	.12	.04	0	17.13	3/25
5	.09	.41	.235	0	18.13	5/17
6	.06%	.30	0	0	16.7	1/10
7	0	0	0	0	0	0
8	.01%	.20	0	0	2.6	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-9

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine Piping/Casing Steam Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.25%	.212	.026	.052	118.4	8/38
2	.04%	.212	.026	0	17.05	6/33
3	.07%	.20	.03	.03	29.3	3/30
4	.06%	.24	0	.08	23.0	6/25
5	0	0	0	.117	0	2/17
6	.04%	.30	0	.40	10.9	3/10
7	0	0	0	.142	0	1/7
8	0	0	0	0	0	0
9	.03%	.20	.20	0	12.0	1/3
10	.01%	.33	0	.33	3.1	2/3
11	0	0	0	0	0	0

TABLE 2F-10

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Generator Exciter Malfunctions

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.06%	.184	.079	0	29.5	7/38
2	.10%	.09	.052	0	103.1	3/33
3	.03%	.033	.033	0	82.2	1/30
4	.06%	.12	.04	.04	12.4	3/25
5	0	.059	.059	0	4.4	1/17
6	.07%	.10	0	0	64.0	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-11

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Generator Hydrogen Cooling System Problems

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.08%	.157	.105	.026	43.3	7/38
2	.11%	.105	0	0	92.3	4/33
3	0	0	0	0	0	0
4	.03%	.04	0	0	70.1	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	.40%	.666	0	.666	52.8	1/3

TABLE 2F-12

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Miscellaneous EHC Problems

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.08%	.578	.289	.079	11.9	15/38
2	.07%	.515	.424	0	12.3	12/33
3	.03%	.233	.20	0	12.1	6/30
4	.03%	.12	.08	.08	23.6	4/25
5	.06%	.35	.18	.059	13.7	4/17
6	0	.10	.10	.10	1.5	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	.14%	1.0	1.0	0	12.3	3/3
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-13

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine/Generator Balancing

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCPAWS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.12	.158	.026	0	403.8	2/38
2	0	.03	.03	0	8.3	1/33
3	.03	.10	.13	0	33.1	2/30
4	0	.04	0	0	4.8	1/25
5	.01%	.05	0	0	9.9	1/17
6	.04%	.30	0	0	33.1	3/10
7	.01%	.285	.14	0	4.5	2/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	.21	1.33	0	0	14.0	1/3
11	.02	.33	0	0	5.7	1/3

TABLE 2F-14

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = MSR Tube Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.07%	.132	.026	0	44.9	3/38
2	.07%	.06	.03	0	102.2	2/33
3	.08%	.10	0	0	73.3	3/30
4	0	.04	0	0	0.1	1/25
5	.02%	.059	0	0	25.0	1/17
6	.05%	.20	.10	0	22.6	2/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-15

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine/Generator Lube Oil System

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.07%	.079	.158	0	78.27	3/38
2	.01%	.06	0	0	15.13	2/33
3	.01%	.066	.033	0	8.4	2/30
4	.05%	.08	0	0	53.45	2/25
5	.01%	.059	0.59	0	10.7	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-16

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = EHC System Electronics Failure

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.08%	.21	.157	0	33.5	7/38
2	.01	.121	.09	0	4.5	4/33
3	0	.033	.033	0	2.5	1/30
4	.01%	.12	.12	0	9.3	3/25
5	0	.059	.059	0	3.4	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-17

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine Control/Stop Valve Closure

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.03%	.132	.072	.052	20.4	5/38
2	.01%	.12	.12	.03	10.0	4/33
3	0	0	0	.03	0	1/30
4	0	.04	0	0	4.8	1/25
5	.01%	.117	0	0	6.5	1/17
6	.02%	.20	.20	0	4.9	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-18

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine/Generator Protection/Trip System Malfunctions

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	.236	.132	0	1.5	7/38
2	.04%	.272	.242	0	12.1	8/33
3	0	.20	.166	0	9.2	6/30
4	.01%	.08	.04	0	7.9	2/25
5	.01%	.235	.235	0	4.8	3/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-19

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine Generator Area Fires

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.06%	.026	.026	0	200.0	1/38
2	0	0	0	.03	0	1/33
3	0	0	0	0	0	0
4	0	.04	0	0	1.7	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-20

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Voltage Regulator Failure

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02%	.21	.158	0	8.8	6/38
2	.01%	.12	.12	0	7.3	1/33
3	0	.20	.10	0	2.0	3/30
4	.01%	.16	.16	0	2.9	1/25
5	.06%	.294	.294	.058	13.0	3/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	.07%	.666	.666	0	8.9	1/3
11	0	0	0	0	0	0

TABLE 2F-21

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Generator Breaker/Relay Malfunctions

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02%	.184	.158	1	11.0	7/38
2	.01%	.09	.09	0	10.53	3/33
3	0	.066	.033	0	2.4	2/30
4	0	0	0	0	0	0
5	.01%	.059	.059	0	7.6	1/17
6	.01%	.10	.10	0	12.7	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	.04%	.333	0	0	10.5	1/3

TABLE 2F-22

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Gland Seal and Extraction Steam System

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	.08	0	.06	5.1	2/30
4	.03%	.117	0	0	33.7	2/25
5	.03%	.10	0	0	20.1	2/17
6	0	0	0	0	3.0	1/10
7	0	0	0	0	0	0
8	0	0	0	.143	0	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-23

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Moisture Separator/Reheater Valve

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.03%	.052	0	0	52.8	2/38
2	0	.03	0	.03	6.6	2/33
3	0	0	0	.066	0	2/30
4	.01%	.04	.04	0	11.2	1/25
5	0	.058	.058	.058	6.1	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	.60	0	3/5
9	0	0	0	.33	0	1/3
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-24

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine/Generator Instrumentation

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.052	.026	.026	9.7	3/38
2	.02%	.09	.09	0	15.9	3/33
3	0	0	0	0	0	0
4	0	0	.04	.04	1.1	2/25
5	0	.059	.059	0	6.7	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	.01%	.20	0	0	5.4	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-25

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine Control/Stop Valve Position Indicator Failure

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.105	.053	0	10.3	2/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	.01%	.04	.04	0	11.2	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-26

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = MSR Level Control

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	.026	.026	0	9.1	1/38
2	.01%	.06	.06	0	9.0	2/33
3	0	.033	0	0	4.5	1/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-27

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = MSR Piping Problem/Maintenance

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	.01%	.03	0	0	22.4	1/33
3	0	.066	.066	0	6.0	1/30
4	0	.04	.04	0	8.8	1/25
5	0	.059	.059	.059	3.0	2/17
6	.023	.20	.10	.10	6.6	3/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	.05%	.333	.333	.333	11.8	2/3

TABLE 2F-28

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = EHC Power Supply Failures

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.053	.026	0	9.7	2/38
2	0	.06	.06	0	5.8	2/33
3	0	.033	.033	0	9.7	1/30
4	.01%	.12	.04	.059	3.6	2/25
5	0	0	0	.059	0	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-29

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine Control/Stop Valve Oper

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	0	0	.03	0	1/33
3	.01%	.166	.13	0	4.0	4/30
4	0	.04	0	0	0.1	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-30

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Turbine Valve Test

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.026	0	.578	49.2	5/38
2	0	0	0	.15	0	4/33
3	0	0	0	.233	0	4/30
4	0	0	0	.32	0	4/25
5	0	0	0	.41	0	5/17
6	0	0	0	.20	0	2/10
7	0	0	0	2.42	0	3/7
8	0	0	0	0	0	0
9	0	0	0	.66	0	1/3
10	0	0	0	1.6	0	2/3
11	0	0	0	2.0	0	2/3

TABLE 2F-31

Commercial Year PWR Problem Profiles

SYSTEM = Turbine Generator

PROBLEM = Generator Transformer Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	.033	.033	0	5.2	1/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-32

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Steam Generator Tube Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.17%	.026	0	0	564.8	1/38
2	1.20%	.12	.06	0	515.3	4/33
3	3.58%	.56	.06	.06	628.2	12/30
4	4.19%	1.16	.04	0	316.4	6/25
5	1.96%	.47	0	0	366.5	6/17
6	1.92%	.60	0	0	281.5	5/10
7	1.64%	.43	0	0	336.6	3/7
8	1.60%	1.0	0	0	142.4	2/5
9	1.16%	.66	0	0	153.5	2/3
10	0.91%	.33	0	0	241.0	1/3
11	0.59%	.33	0	0	157.7	1/3

TABLE 2F-33

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Miscellaneous MSIC Malfunctions/Maintenance

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.23%	.289	.158	.026	70.69	11/38
2	.18%	.09	.06	0	175.36	3/33
3	.09%	.233	.10	0	35.2	4/30
4	.04%	.08	.08	0	48.5	2/25
5	.06%	.117	.117	0	49.35	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	.20	.20	0	5.7	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-34

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Steam Line Modification/Repair

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.33%	.052	.026	0	558.95	3/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-35

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = MSIV Closure, Cause Unknown

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.25%	.368	.368	.026	58.4	8/38
2	.06%	.15	.150	0	32.0	4/33
3	.03%	.20	.166	0	11.8	5/30
4	.01%	.40	.40	0	11.0	1/25
5	0	0	0	0	0	0
6	0	.10	.10	0	4.2	1/10
7	0	.286	.286	0	12.7	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-36

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Steam Line Drain Line Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.132	.079	0	10.9	3/38
2	0	0	0	0	0	0
3	.17%	.033	0	0	459.8	1/30
4	.02%	.04	0	0	40.9	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-37

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = MSIV Solenoid Valve Failures

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.14%	.026	.026	.026	229.5	2/38
2	0	.06	.06	.06	5.3	2/33
3	0	0	0	0	0	0
4	0	.04	.04	.04	1.2	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	.07%	.286	.286	.286	21.4	1/7
8	.01%	.20	.20	.20	5.7	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-38

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Steam Leaks on Instrument Taps

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.026	0	0	27.2	2/38
2	0	.06	0	0	14.3	1/33
3	.02%	.033	0	0	53.4	1/30
4	.09%	.04	0	0	195.2	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-39

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Unidentified Secondary Side Steam Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.06%	.026	.026	0	68.9	1/38
2	.01%	.03	0	0	16.1	1/33
3	0	0	0	.066	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	.06%	.10	0	0	52.5	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-40

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Steam Generator Manhole Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	.04%	.03	0	0	144.0	1/33
3	.03%	.06	0	0	39.75	2/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	.20	0	1/5
9	.01%	.40	.20	.40	50.4	1/3
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-41

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Instrumentation Valve Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	026	0	0	38.4	1/38
2	0	0	0	0	0	0
3	.01%	.033	0	0	16.6	1/30
4	.03%	.04	0	0	83.2	1/25
5	.07%	.117	0	.059	118.6	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-42

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Steam Dump Valve

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.052	0	0	19.3	1/38
2	.04%	.03	03	0	101.1	1/33
3	0	.033	.033	0	1.2	1/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-43

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Main Steam Safety Valve

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.03%	.026	.026	0	101.5	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-44

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = MSIV Control Circuitry

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.079	.079	0	13.53	3/38
2	.01%	.06	.06	0	12.4	1/33
3	0	0	0	0	0	0
4	0	.04	.04	0	4.2	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	4.7	1/3
10	.02%	.333	.333	0	0	0
11	0	0	0	0	0	0

TABLE 2F-45

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Steam System Instrumentation Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.079	.052	.026	8.76	4/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	.02%	.059	.059	0	39.6	1/17
6	0	0	0	0	0	0
7	.01%	.143	.143	0	6.7	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-46

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Steam System Test

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	.052	0	2/38
2	0	0	0	0	0	0
3	0	.033	0	0	10.5	1/30
4	0	0	0	0	0	0
5	0	0	0	.16	0	2/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	.2	0	1/5
9	0	0	0	0	0	0
10	0	0	0	333	0	1/2
11	0	0	0	0	0	0

TABLE 2F-47

Commercial Year PWR Problem Profiles

SYSTEM = Main Steam

PROBLEM = Steam Generator Inspection and Maintenance

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.05%	.026	.026	0	179.8	1/38
2	.39%	.066	0	0	568.4	2/33
3	.50%	.10	0	0	656.0	2/30
4	.42%	1.20	0	0	309.2	3/25
5	2.5 %	.47	0	0	481.6	7/17
6	.38%	0.10	0	0	333.8	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	2.45%	.666	0	0	199.4	2/3
11	.59%	.333	0	0	157.7	1/3

TABLE 2F-48

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = RCP Shaft Failure

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.23%	.026	.026	0	768.0	1/38
2	.74%	.03	.03	0	2152.0	1/33
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-49

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = Unidentified Repairs/Malfunctions

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.31%	.079	.026	0	346.5	3/38
2	.39%	.03	.03	0	1133.6	1/33
3	.0	.033	.033	.033	9.4	2/30
4	.0	.04	.04	0	8.4	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-50

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = RCP Lube Oil System Problems

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.32%	.158	.026	.052	180.3	8/38
2	.02	.06	.03	.212	37.5	5/33
3	.10%	.166	0	.266	54.3	6/30
4	.03%	.24	0	.36	11.2	6/25
5	.02%	.176	0	.059	12.2	4/17
6	.028%	.10	0	0	24.9	1/10
7	0	0	0	0	0	0
8	.07%	.2	.2	0	31.8	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-51

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = RCP Motor Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.15%	.026	0	0	507.5	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	.08%	.04	0	0	168.0	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	.06%	.143	0	0	34.1	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-52

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = Seal Injection System

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.026	0	0	41.3	1/38
2	.09%	.03	.03	0	265.9	1/33
3	.01%	.033	0	0	21.5	1/30
4	.14%	.16	.08	0	78.4	4/25
5	.07%	.059	0	.059	98.9	1/17
6	.27%	.10	0	0	237.1	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-53

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = Excess RCP Vibration

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	.026	0	1/38
2	.10	.06	0	0	137.6	2/33
3	.0	.033	0	0	7.5	1/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	.19	.143	0	0	118.1	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-54

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = Seal Controlled Leakoff System

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01	.026	0	0	37.2	1/38
2	.07	.06	0	0	99.5	2/33
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	.24	.143	.143	0	148.1	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-55

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = Seal Pressure Sensing Line Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	.026	0	0	2.7	1/38
2	.07%	.09	.03	0	62.9	1/33
3	.04%	.033	0	0	99.4	1/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-56

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = RCP Cooling Heat Exchanger Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	.026	0	0	7.9	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-57

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = RCP Motor Surge Suppression Capacitor Failures

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.052	.026	0	23.7	2/38
2	0	0	0	0	0	0
3	.01%	.066	.066	0	15.0	1/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-58

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = RCP Instrumentation Malfunction

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	.02%	.066	.066	.033	22.7	3/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	.666	0	2/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-59

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = General Maintenance/Testing

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	.01%	.03	.03	.06	18.8	3/33
3	0	0	0	0	0	0
4	0	0	0	.04	0	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-60

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = Seal Vent Line Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.052	0	0	14.4	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-61

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant Pump

PROBLEM = RCP Seal Failure

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.81%	.236	.052	0	298.9	5/38
2	1.27%	.363	.09	0	306.9	9/33
3	.08%	.033	0	0	222.2	1/30
4	.82%	.24	.12	0	300.0	6/25
5	.90%	.352	.176	0	224.0	3/17
6	1.13%	.30	.30	0	329.9	3/10
7	.26%	.143	0	0	160.4	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-62

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = CEA Repatch/Changeout

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.12%	.052	0	0	207.5	2/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	.01%	.04	0	0	25.4	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-63

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = CRDM Housing Seal Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.34%	.857	0	.052	189.6	1/38
2	0	0	0	0	0	0
3	.09%	.03	0	0	237.1	1/30
4	.18%	.08	.04	0	198.4	2/25
5	.18%	.117	.117	0	137.4	1/17
6	.27%	.10	0	0	241.0	1/10
7	1.90%	1.28	.143	0	129.7	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-64

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = CEA Drop/Control Rod Drive Mechanism Failures

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.12%	.236	.132	.026	46.5	5/38
2	.18%	.151	0	.03	102.8	4/33
3	.05	.10	0	0	46.5	3/30
4	.2%	.20	0	0	88.3	3/25
5	.02	.059	0	.117	11.4	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	.09%	.20	0	0	12.0	1/3
11	0	0	0	0	0	0

TABLE 2F-65

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = Control Rod Drive Mechanism Failures

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	052	0	0	23.8	2/38
2	.13%	.09	.03	0	127.4	3/33
3	.01%	.033	0	0	29.5	1/30
4	12%	.20	.04	.04	50.7	2/25
5	.04%	.117	0	0	29.8	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-66

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = CEA Drop Cause Not Identified

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.03%	368	289	.132	9.4	11/38
2	.01%	06	.06	.03	9.85	3/33
3	06%	.10	.06	.033	56.6	4/30
4	.01%	.04	0	0	15.5	1/25
5	.05%	176	.117	.059	27.1	2/17
6	.08%	.40	10	.20	17.7	3/10
7	.10%	.428	143	0	21.2	2/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-67

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = CRDMs Inoperable

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.10%	.052	.026	.026	162.2	3/38
2	.02%	.06	.03	.03	29.8	3/33
3	0	0	0	0	0	0
4	.02%	.08	.04	.12	26.6	2/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	.08%	.286	0	0	25.3	2/7
8	.07%	0.2	0	0	30.0	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-68

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = CEA Drop - Faulty Connections

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.11%	.079	.079	0	116.8	3/38
2	.01%	.03	.03	0	19.0	1/33
3	0	.033	0	.033	6.3	1/30
4	0	0	0	.04	0	1/25
5	0	.059	0	.059	6.9	2/17
6	.01%	.10	0	.10	12.0	2/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-69

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = CEA Drop/Control Electronic Failure

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.07%	.263	.21	0	23.9	10/38
2	.03%	.303	.182	.06	9.6	8/33
3	.01%	.066	.066	0	7.7	2/30
4	.01%	.08	.08	0	8.2	2/25
5	.01%	.059	0	0	8.5	1/17
6	0	0	0	0	0	0
7	.01%	.143	.143	0	3.6	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-70

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = CRDM Cooling System Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	.03%	.06	.03	0	50.5	2/33
3	.02%	.066	.033	0	31.1	2/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	.12%	.286	.286	0	36.6	2/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-71

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = CEA Drop/Power Supply Failures

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02%	.105	.079	.026	14.5	5/38
2	.02%	.121	.09	.03	16.8	2/33
3	.01	.066	.066	.033	7.9	3/30
4	.05	.16	.12	.12	29.4	5/25
5	.02%	.176	.117	0	9.2	3/17
6	0	0	0	.10	0	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-72

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = CEA Drop/Power Relay Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02%	.026	.026	0	72.0	1/38
2	.05%	.09	.09	.03	45.6	1/33
3	.01	.066	.066	0	8.4	2/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-73

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = General CEA Testing/Maintenance

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.03%	.026	.026	0	88.8	1/38
2	.03%	.03	0	0	91.7	1/33
3	.01%	.066	.033	.033	10.95	2/30
4	0	0	0	.04	0	1/25
5	0	0	0	0	0	0
6	.01	.10	.10	0	0	1/10
7	0	0	0	0	0	0
8	0	0	.0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-74

Commercial Year PWR Problem Profiles

SYSTEM = Control Rod System, Rods, Drives, Controls

PROBLEM = Motor Generator Breaker Malfunctions

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	.026	.026	0	7.6	1/33
3	.01%	.066	.066	0	19.4	1/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-75

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Control Valves - General

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.44	.289	.263	.026	134.2	9/38
2	0	.03	.03	0	20.1	1/33
3	.09	0.3	.266	.033	26.0	6/30
4	.11	.24	.20	.04	40.4	6/25
5	.11	.117	.059	0	85.4	2/17
6	.05	.50	.50	0	9.4	4/10
7	0	.143	.143	0	3.0	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-76

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Miscellaneous Feedwater System Piping

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.19%	.158	.079	.079	159.0	6/38
2	.19%	.18	0	.09	91.7	6/33
3	.06%	.333	0	0	145.0	10/30
4	.0	.04	0	0	9.9	1/25
5	0	0	0	.059	0	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	.04	0	1/5
9	0	0	0	0	0	0
10	0	0	0	.333	0	0
11	0	0	0	0	0	0

TABLE 2F-77

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Pump Speed Controller

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.38%	.132	.105	.052	252.7	6/38
2	.03%	.151	.151	.121	14.6	4/33
3	0	.10	.10	.10	4.0	4/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-78

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater

PROBLEM = Feedwater Control System

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.12%	.50	.50	0	21.7	10/38
2	.03%	.30	.30	0	9.7	7/33
3	0	.033	0	0	16.0	1/30
4	.01%	.12	.12	.04	6.8	2/25
5	0	.176	.176	0	6.4	3/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-79

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Pump Trips Miscellaneous Causes

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.28%	.684	.605	0	36.2	15/38
2	.02%	.212	.212	.303	7.5	7/33
3	.01%	.20	.20	0	5.8	5/30
4	.01%	.12	.12	0	8.8	3/25
5	.01%	.117	.117	0	8.0	2/17
6	.08%	.40	.40	0	18.0	1/10
7	.09%	.428	.428	0	18.0	1/7
8	.04%	.20	.20	0	16.1	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-80

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Level Trips, PWR Level Unknown

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.11%	1.29	1.29	0	7.6	11/38
2	.15%	.72	.72	.03	17.8	6/33
3	.02%	.80	.80	0	2.3	3/30
4	.01%	.20	.20	0	3.4	4/25
5	.01%	.235	.235	0	3.7	2/17
6	0	.10	.10	0	2.3	1/10
7	.02%	.286	.286	0	6.5	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-81

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Miscellaneous Feedwater System Problems/Maintenance

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.105	.052	.052	8.8	5/38
2	.0	.06	.06	.03	4.7	3/33
3	.03%	.133	.10	.033	177.3	4/30
4	0	0	0	0	3.0	0
5	0	.059	.059	.059	3.0	2/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	.02%	.333	.333	0	5.6	1/3

TABLE 2F-82

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Heater Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.026	0	0	28.9	1/38
2	.09%	.151	0	.09	54.6	5/33
3	.01%	.03	0	.03	18.1	2/30
4	.01%	.04	.04	.2	24.3	3/25
5	.02%	.176	.059	0	9.3	2/17
6	.07%	.20	.10	.2	29.9	2/10
7	.03%	.286	0	.142	8.6	1/7
8	.17%	.20	0	.20	75.4	2/5
9	.15%	.333	0	.666	41.8	1/3
10	0	0	0	.333	0	1/3
11	0	0	0	0	0	0

TABLE 2F-83

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Level Trips During Startup

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.04 ^a	.92	.92	0	3.8	13/38
2	.04 ^a	.72	.60	0	4.9	11/30
3	.03 ^c	.60	.60	0	4.0	9/30
4	.02	.52	.44	0	3.6	4/25
5	.03 ^a	.58	.58	0	3.4	7/17
6	0	.30	0	.30	.63	3/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	.02 ^c	.333	0	0	4.5	1/3

TABLE 2F-84

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater System Check Valve

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.06	.079	0	.052	71.3	3/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	.07 ^a	.04	0	0	158.3	1/25
5	0	0	0	.059	0	1/17
6	.01	.20	.10	0	2.7	2/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-85

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Heater Drain Tank

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.04%	.132	.079	.079	24.7	7/38
2	.05	.182	.132	0	21.6	5/33
3	.03%	.133	.033	0	18.8	1/30
4	0	.04	.04	0	3.2	1/25
5	.01%	.176	.059	.294	4.4	4/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	.333	0	1/3
11	0	0	0	0	0	0

TABLE 2F-86

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Control Valve - Operator Malfunctions

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01	.184	.184	0	6.3	6/38
2	.04%	.212	.212	.03	15.9	4/33
3	.01%	.166	.166	.033	2.9	3/30
4	.02%	.20	.20	0	10.6	4/25
5	.05%	.294	.352	.059	15.7	5/17
6	.03%	1.0	0	0	25.5	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-87

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = General Feedwater Maintenance/Repair

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.03%	.132	.079	.079	19.0	6/38
2	.04%	.121	.09	.182	29.6	7/33
3	.01%	.066	.066	.066	15.4	2/30
4	0	0	0	.08	0	2/25
5	0	0	0	.059	0	1/17
6	0	0	0	.117	0	2/10
7	.01%	.143	.143	.143	8.2	2/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-88

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Control Valve Bypass Valve

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.08%	.184	.132	0	37.8	6/38
2	0	0	0	0	0	0
3	.01%	.133	.133	0	6.1	2/30
4	0	0	0	0	0	0
5	.01%	.059	0	0	11.5	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-89

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Control Valve Malfunctions

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.04%	.132	.105	0	24.5	4/38
2	.03%	.121	.09	0	18.3	4/33
3	.01	.10	.066	.033	8.2	4/30
4	0	0	0	.04	0	1/25
5	0	0	0	0	0	0
6	.03%	.10	0	0	27.1	1/10
7	.02%	.143	0	.143	11.6	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-90

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Heater Drain Tank Pump

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.105	.105	.236	10.2	6/38
2	.05%	.12	.151	.182	36.7	6/33
3	.02%	.10	.033	.066	13.5	3/30
4	0	0	0	.28	0	4/25
5	0	0	0	.41	0	3/17
6	.01%	.10	.50	.50	7.5	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	.333	0	1/3
10	0	0	0	0	0	0
11	0	0	0	.333	0	1/3

TABLE 2F-91

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Pump Instrumentation/Piping

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02 ²	.158	.105	.236	9.1	8/38
2	0	.03	0	.212	5.1	3/33
3	0	.066	.066	.066	6.05	4/30
4	0	.04	0	.20	5.1	6/25
5	0	0	0	0	0	0
6	0	0	0	.10	0	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-92

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Condensate/Condensate Booster Pump

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.03 ⁴	.052	.053	.315	41.8	3/38
2	0	.151	.151	.09	2.6	5/33
3	.01 ¹	.09	.09	.03	5.26	3/30
4	0	0	0	0	0	0
5	0	0	0	.059	0	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-93

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Pump Mechanical

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02%	.079	.052	36.8	24.7	7/38
2	0	0	0	.121	0	3/33
3	0	0	0	.166	0	4/30
4	0	0	0	.12	0	2/25
5	.05%	.117	.117	.059	34.4	3/17
6	0	0	0	.3	0	2/10
7	0	0	0	.571	0	3/7
8	0	0	0	0.2	0	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	.333	0	1/3

TABLE 2F-94

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Miscellaneous Feedwater System Valve

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02%	.132	.026	.026	11.9	6/38
2	.01%	.03	0	.03	16.7	2/33
3	.01%	.066	0	0	10.4	1/30
4	0	.08	.04	.08	2.8	3/25
5	0	0	0	0	0	0
6	.02%	.10	0	0	19.4	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-95

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater System Instrumentation

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.132	.132	0	4.88	5/38
2	0	.03	0	.03	9.9	2/33
3	.01%	.10	.033	9	9.9	3/30
4	.01%	.04	.04	0	2.0	1/25
5	.02%	.176	.059	.059	7.6	2/17
6	0	0	0	0	0	0
7	.01%	.143	.143	0	4.7	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-96

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Pump Lube Oil System

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.0	.052	.052	.105	3.0	4/38
2	0	0	0	.121	0	4/33
3	.03%	.133	.133	.066	22.6	5/30
4	.0	.08	.08	.08	5.0	4/25
5	.0	.059	.059	.059	1.7	2/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-97

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater System Pump Suction Strainer

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	02	105	.105	2.36	13.7	4/38
2	0	0	0	.121	0	2/33
3	0	.033	0	.033	5.5	2/30
4	0	0	0	.04	0	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-98

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Isolation Valve

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	02 ^c	.079	.026	0	65.8	3/38
2	01	.06	.03	.03	7.7	1/33
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	.059	.059	0	2.1	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11						

TABLE 2F-99

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Heater Level Control

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	.01	.066	.033	0	14.7	2/30
4	0	0	0	.08	0	2/25
5	0	0	0	.059	0	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-100

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Pump Seal/Packing

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01	.026	0	0	29.2	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	.04	0	1/25
5	0	0	0	0	0	0
6	0	0	0	.10	0	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	.333	0	1/3

TABLE 2F-101

Commercial Year PWR Problem Profiles

SYSTEM = Main Feedwater System

PROBLEM = Feedwater Pump Recirculation Valve

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	.026	.026	0	5.2	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-102

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = Pressurizer Safety/Relief Valve Leakage

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.46%	.158	0	.026	259.3	5/38
2	.17%	.09	0	0	164.5	2/33
3	.01%	.033	0	0	17.1	1/30
4	.20%	.04	0	0	225.1	1/25
5	.10%	.117	0	0	76.2	1/17
6	.07%	.10	0	0	65.1	1/10
7	0	0	0	0	0	0
8	.29%	.20	0	0	127.4	1/5
9	0	0	0	.333	0	1/3
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-103

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = Miscellaneous RCS Valve Leakage

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.12%	.184	.026	0	58.4	5/38
2	.38%	.242	.03	0	137.4	7/33
3	.10%	.30	0	0	29.18	6/30
4	.10%	.32	0	0	30.4	2/25
5	.08%	.117	0	0	60.65	2/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	.666	0	2/3
10	0	0	0	.666	0	1/3
11	0	0	0	0	0	0

TABLE 2F-104

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = Pressurized Spray Valve

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.36%	.447	0	.026	72.3	10/38
2	.09%	.242	.03	0	34.2	2/33
3	.02%	.10	0	0	21.4	3/30
4	.09%	.12	.08	0	70.4	1/25
5	.01%	.059	.059	0	8.9	2/17
6	0	0	0	0	0	0
7	.08%	.143	0	0	50.6	1/7
8	.04%	.20	0	0	19.0	1/5
9	0	0	0	.333	0	1/3
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-105

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = Miscellaneous Maintenance or Test

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.07%	.052	.026	.052	123.3	4/38
2	0	0	0	.06	0	2/33
3	.01%	.033	.033	.066	36.4	3/30
4	0	0	0	.04	0	1/25
5	0	0	0	0	0	0
6	.01%	.10	0	0	9.0	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	.89%	.333	0	.666	235.9	1/3

TABLE 2F-106

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = Pressurized Manway Gasket Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	.04%	.06	0	0	60.8	1/33
3	.04%	.033	0	0	96.0	1/30
4	.20%	.12	0	0	151.9	3/25
5	.04%	.059	0	0	53.3	2/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-107

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = Loop Isolation Valve

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.17%	.026	.026	0	578.4	1/38
2	.01%	.03	.03	0	17.9	0
3	.03%	.066	0	0	33.3	2/30
4	.01%	.04	0	0	11.0	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	.333	0	1/3
11	0	0	0	.333	0	1/3

TABLE 2F-108

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = Blown Rupture Disc on Quench Tank

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.05%	.026	0	0	184.0	1/38
2	.06%	.03	0	0	174.3	1/33
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-109

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = Unidentified Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.06%	.21	0	0	24.0	5/38
2	.01%	.06	0	0	18.7	2/35
3	.04%	.03	0	0	92.9	1/30
4	0	.033	0	0	.1	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-110

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = Instrumentation Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.07%	184	.132	026	32.8	5/38
2	.01%	09	.06	0	12.3	3/33
3	0	.033	0	0	7.8	1/30
4	.01%	.08	.08	0	7.1	2/25
5	0	0	0	04	0	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-111

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = Instrumentation Valve Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	.26	0	0	8.4	1/38
2	.09%	.09	0	.03	87.9	2/33
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-112

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = RTD Failures

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	.026	0	1/38
2	0	.03	0	.03	0	1/33
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-113

Commercial Year PWR Problem Profiles

SYSTEM = Reactor Coolant System

PROBLEM = Return Isolated Loop to Service

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.026	0	0	35.0	1/38
2	0	0	0	0	0	0
3	0	.03	0	0	3.8	1/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-114

Commercial Year PWR Problem Profiles

SYSTEM = On-Site Power Systems

PROBLEM = Cable Fire

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	1.39%	.052	.052	0	2314.0	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-115

Commercial Year PWR Problem Profiles

SYSTEM = On-Site Power Systems

PROBLEM = Non-Vital Instrument Bus Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.39%	.236	.184	0	146.9	7/38
2	.03%	.242	.212	.03	13.4	7/33
3	.03%	.333	.30	0	7.9	7/30
4	.01%	.20	.20	0	4.6	3/25
5	.02%	.294	.176	0	5.4	3/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-116

Commercial Year PWR Problem Profiles

SYSTEM = On-Site Power Systems

PROBLEM = General Maintenance and Tests

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.11%	.052	0	0	187.5	2/38
2	.11%	.03	0	0	318.5	1/33
3	0	0	0	0	0	0
4	0	.033	0	0	0.3	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-117

Commercial Year PWR Problem Profiles

SYSTEM = On-Site Power Systems

PROBLEM = Circuit Breaker/Switch Malfunctions

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.10%	.184	.158	0	45.5	5/38
2	.02%	.09	.09	0	20.0	3/33
3	.01%	.166	.166	0	3.1	3/30
4	0	0	0	0	0	0
5	0	.059	.059	0	2.8	1/17
6	0	.10	.10	0	0.6	1/10
7	.03%	.143	.143	0	20.1	1/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	.01%	.333	.333	0	2.8	1/3

TABLE 2F-118

Commercial Year PWR Problem Profiles

SYSTEM = On-Site Power Systems

PROBLEM = Non-Vital Bus Inverter/Power Supply Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02%	.052	.052	0	29.6	2/38
2	.01%	.09	.06	0	11.7	3/33
3	.07%	.233	.20	.033	25.4	6/33
4	.02%	.24	.24	0	8.7	5/25
5	.02%	.176	.176	0	9.7	3/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-119

Commercial Year PWR Problem Profiles

SYSTEM = On-Site Power Systems

PROBLEM = Vital Bus Inverter/Power Supply Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.05%	.289	.342	.079	16.5	8/38
2	.02%	.151	.151	.09	12.96	6/33
3	0	0	0	0	0	0
4	0	.10	.10	.033	3.4	2/25
5	.01%	.117	.117	.059	10.2	3/17
6	.04%	.20	.10	.10	16.6	3/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	.333	0	1/3
11	.01%	.333	.333	0	0	1/3

TABLE 2F-120

Commercial Year PWR Problem Profiles

SYSTEM = On-Site Power Systems

PROBLEM = Voltage Frequency Fluctuation on Bus, Cause Not Given

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.03%	.079	.079	0	35.1	3/38
2	.01%	.151	.151	0	7.5	4/33
3	.02%	.266	.233	0	5.8	4/30
4	0	.04	.04	0	3.6	1/25
5	0	0	0	0	0	0
6	.01%	.10	.10	0	4.5	1/10
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-121

Commercial Year PWR Problem Profiles

SYSTEM = On-Site Power Systems

PROBLEM = Transformer Failures

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.052	.052	0	24.6	2/38
2	.01%	.03	.03	0	21.1	1/33
3	.02%	.033	0	.10	41.3	2/30
4	0	0	0	0	0	0
5	.10%	.10	.10	0	85.3	1/47
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-122

Commercial Year PWR Problem Profiles

SYSTEM = On-Site Power Systems

PROBLEM = Vital Bus Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02%	.052	.052	0	26.1	2/38
2	.01%	.09	.09	.06	9.7	4/33
3	0	0	0	0	0	0
4	.01%	.08	.08	.04	6.16	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	.666	.333	.333	5.8	1/3
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-123

Commercial Year PWR Problem Profiles

SYSTEM = On-Site Power Systems

PROBLEM = Battery System Faults

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.01%	.079	.079	0	6.8	2/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-124

Commercial Year PWR Problem Profiles

SYSTEM = Condenser System

PROBLEM = Condenser Tube Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.32%	.39	.026	.289	72.4	11/33
2	.51%	.333	.03	.878	134.6	13/33
3	.59%	.133	.066	.333	388.8	10/30
4	1.00%	.12	.04	1.08	735.9	9/25
5	.11%	.41	.059	1.11	24.2	7/17
6	.03%	.10	0	6.2	24.1	5/10
7	0	0	0	2.0	0	3/7
8	0	0	0	0.6	0	3/5
9	0	0	0	.333	0	1/3
10	0	0	0	.333	0	1/3
11	0	0	0	1.66	0	2/3

TABLE 2F-125

Commercial Year PWR Problem Profiles

SYSTEM = Condenser System

PROBLEM = Miscellaneous Condenser System Piping

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.07%	.026	0	0	231.1	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-126

Commercial Year PWR Problem Profiles

SYSTEM = Condenser System

PROBLEM = Loss of Condenser Vacuum, Miscellaneous Causes

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.05%	.184	.105	.079	24.3	8/38
2	0	.06	0	.03	6.7	3/33
3	0	.033	0	0	0.1	1/30
4	0	.04	.04	0	4.3	1/25
5	.04%	.117	.059	.059	29.2	2/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	.333	0	1/3
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-127

Commercial Year PWR Problem Profiles

SYSTEM = Condenser System

PROBLEM = Condenser Tests and Unidentified Maintenance

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.03%	.052	.026	.079	42.0	4/38
2	0	.06	0	.09	6.7	3/33
3	0	0	0	.333	0	4/30
4	.03%	.08	0	.20	35.6	5/25
5	0	0	0	.294	0	3.17
6	.02%	.10	0	.60	16.9	3/10
7	0	0	0	1.00	0	2/7
8	0	0	0	.40	0	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-128

Commercial Year PWR Problem Profiles

SYSTEM = Condenser System

PROBLEM = Condenser Cleaning - Backwashing

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	.236	0	4/38
2	0	0	0	.09	0	1/33
3	.01%	.033	0	.166	34.0	5/30
4	.02%	.04	0	.12	37.3	3/25
5	0	0	0	.352	0	3/17
6	0	0	0	0.200	0	2/10
7	0	0	0	.428	0	1/7
8	0	0	0	.60	0	1/5
9	0	0	0	0	0	0
10	0	0	0	.333	0	1/3
11	0	0	0	1.0	0	1/3

TABLE 2F-129

Commercial Year PWR Problem Profiles

SYSTEM = Condenser System

PROBLEM = Air Ejector

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	.052	0	1/38
2	0	.03	.03	0	6.0	1/33
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	.10	0	1/10
7	.01%	.143	1.43	1.43	7.8	2/7
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-130

Commercial Year PWR Problem Profiles

SYSTEM = Condenser System

PROBLEM = Hotwell Pump

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	.04	.04	.04	1.2	2/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-131

Commercial Year PWR Problem Profiles

SYSTEM = Condenser System

PROBLEM = Vacuum Pump

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	.026	.026	0	.10	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-132

Commercial Year PWR Problem Profiles

SYSTEM = Condenser System

PROBLEM = High Condenser Temperature Differential

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	.04	0	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-133

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = CVCS Piping Modification

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.30%	.026	0	0	1000.3	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-134

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = Tank Boron Concentration Anomalies

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	.026	.026	0	8.1	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	.04	0	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-135

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = Repair of Miscellaneous CVCS Valves

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02%	.052	.026	.026	108.4	2/38
2	.02%	0	0	0	0	0
3	.04%	.033	0	.033	99.3	2/30
4	0	.04	0	0	10.2	1/25
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-136

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = Letdown Valve Packing Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.05%	.026	0	0	168.0	1/38
2	0	.03	0	0	21.4	1/33
3	.04%	.10	.033	0	35.3	2/30
4	0	0	0	0	0	0
5	.01%	.059	0	0	21.9	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	.09%	.20	.20	0	39.0	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-137

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = Regenerative Heat Exchanger Leak

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	.11%	.5	.059	0	166.1	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-138

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = CVCS Piping Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	.04%	.03	0	0	109.8	1/33
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	.20	0	1/5
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-139

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = Charging Line Check Valve Repair

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02%	.026	.026	0	79.0	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-140

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = Letdown Temperature Control Valve Failure

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	.03%	.033	0	0	77.4	1/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-141

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = CVCS Relief Valve Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	01%	026	026	0	22 0	1/38
2	01%	03	0	0	17 0	1/33
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-142

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = Auxiliary Pressurizer Spray Valve Malfunction

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	033	033	0	11 0	1/30
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-143

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = Make Up Controller Malfunction

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	0	0	0	0	0	0
2	0	0	0	.03	0	1/33
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

TABLE 2F-144

Commercial Year PWR Problem Profiles

SYSTEM = Chemical and Volume Control System

PROBLEM = Charging Pump Filter Weld Leaks

YEAR	AVERAGE ANNUAL UNAVAILABILITY CONTRIBUTION	TOTAL SHUTDOWNS PER PLANT YEAR	SCRAMS PER PLANT YEAR	POWER REDUCTIONS PER PLANT YEAR	AVERAGE SHUTDOWN DURATION	FRACTION OF PLANTS AFFECTED
1	.02%	.026	.026	0	61.6	1/38
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	.04%	.08	0	0	45.5	1/25
5	.03%	.059	0	0	47.0	1/17
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

APPENDIX 3.1-A

Main Steam Isolation Valve
Problems Summary

3.1-A-i/3.1-A-ii

APPENDIX 3.1-A MAIN STEAM ISOLATION VALVES

The following are summaries of the discussions with plant personnel and are typical of the problems identified and the corrective actions that have been taken:

Plant 1 -- Worn actuator bushings, worn actuator "O" rings, broken rockshaft keys

These valves are back-to-back check valves. The following repairs were performed; larger pneumatic actuator pistons were installed, flow control needle valves were installed on the actuator vent lines to cushion closing stroke, the broken rockshaft keys were replaced with spline type connections, and disc up travel was adjusted to lift the disc higher out of flow path to prevent flow induced flutter and inadvertent closures.

Plant 2 -- Valve failed closed, reactor tripped

The pilot solenoid which is utilized to dip the valve for inservice testing failed and the MSIV closed. The faulty solenoid was replaced.

Plant 3 -- Inadvertent closures and repairs

These valves are back-to-back check valves with pneumatic piston actuators. Most of the closures were attributed to the disc hanging down into the steam flow even though the valve is open. The disc up-travel stop was reworked to allow the disc to lift higher out of the flow stream. A higher pressure air cylinder actuator was installed on one valve. Both these actions help to eliminate flow induced inadvertent closures. The pilot air solenoid valves were unstable, prone to tripping off. This was initially felt to be an operational problem and operation of the valves for inservice tests was limited to supervisory personnel. The problem with the "hair trigger" solenoids was eventually resolved by changing to different solenoids.

Plant 4 -- Valve failed closed

Valve failed closed during testing, a pin sheared between the stem and disc, and the limit switch which restricts stem movement failed. These valves are back-to-back check valves with pneumatic piston actuators. The failed limit switch caused the valve to go closed and resulted in the damaged parts. These valves have been backfitted with larger actuators and stronger internal parts. This has corrected the problems.

Plant 5 -- Inadvertent closures

These valves are back-to-back check valves with pneumatic actuators. Flutter of the valve disc is believed to have caused cracks in the rockshaft and erroneous limit switch signals which tripped the turbine. Larger air actuators were installed. Rockshaft problems were corrected by converting the original keyed connections to spline connections.

Plant 6 -- Inadvertent closures, valve stuck open, flutter

These valves are back-to-back check valves with pneumatic actuators. An up travel stop was added to keep the disc from swinging up to high where it could stick or jam in the open position. A larger actuator was backfitted to alleviate the flutter problem. Greater resistance to flutter helps eliminate the dip situation which sometimes leads to inadvertent closings when the disc flutters too far into the flow path.

Plant 7 -- Ground in control circuit, stuck hydraulic actuator

These valves are hydraulic actuated globes. Actuator problems have been attributed to stuck or sluggish solenoid coils which have been replaced with heavier coils. Additionally, program for exercising the solenoids was incorporated. A manufacturing error was also discovered which may have added to the valve sticking open. The backseat taper was too shallow such that the seat angle did not assist the stem in remaining centered. The stem could scrap the backseat bore. Further, the actuator put out approximately

twice as much force as needed. Modified backseats and stems were installed by the manufacturer and actuator force was cut back. The actuator system is hard to maintain. Individual hydraulic and gas systems are located remotely from the valve operator. There is "too much equipment, too many components, it is a spares problem too".

Plant 8 -- Inadvertent closure

These valves are back-to-back check valves with pneumatic piston actuators. Stronger internals were installed to meet guillotine break criteria. The new parts are heavier than the originals, thus adding to the dip induced closure problem. A larger pneumatic actuator was installed and the air pressure was increased.

Plant 9 -- Inadvertent closures

These valves are back-to-back check valves with pneumatic piston actuators. The closures were caused by the disc hanging down into the flow and the actuator not being powerful enough. The valve top cover was reworked to permit the disc to lift higher. New larger piston actuators were installed.

APPENDIX 3.1-B

PRESSURIZER SPRAY VALVE
PROBLEMS SUMMARY

3.1B-i/3.1B-ii

APPENDIX 3.1-B
PRESSURIZER SPRAY VALVES

The following summaries of interviews with plant personnel are typical of the problems identified and the corrective actions taken:

Plant 1 -- Packing leakage

Valves were originally supplied with Crane 187I. The utility has switched packing to Grafoil rings. This has reduced the problem. If the leak occurs again, the utility plans to install a combination of Crane braided Graphite 1625 GF and preformed Grafoil rings. The utility learned about this change from recommendations in an article written by Fisher Controls.

The valves are located inside the pressurizer house where high ambient temperature and background radiation make it difficult to perform maintenance. The last time the valves were repacked, the valves were taken apart.

Plant 2 -- Bellows leakage

The original valves were 4-inch air operated globes with bellows stem seals. The utility experienced bellows failures which they believe were due to the valve environment (located inside hot pressurizer house) and excessive operating cycles. Their back-up pressurizer heaters are oversized and this requires them to spray (cycle) often. They relocated the valves outside the pressurizer house and replaced them with pneumatic operated ball valves.

Plant 3 -- Packing leakage/seat leakage

Valves are 3-inch conventional packed air operated globes. This utility experienced seat leakage due to misalignment of the valve cage in the valve body. This problem was corrected by the valve supplier by removal of some alignment nipples that did not fit the holes and thus held the cage up off its bottom gasket resulting in leakage when the valve was closed.

The packing leakage problem is most likely from packing fatigue, Grafoil and 187I are used. The utility has ordered replacement bellows seal bonnets which they believe will solve the problem. This utility does not have isolation valves around the spray valves such that they must drain down to repair their valves.

Plant 4 -- Packing leakage

Valves are 3-inch ball valves with pneumatic operators. Some packing leakage problems in 1977 were eliminated by installing Grafoil. Assembly of the ball to the drive shaft is critical. This is a spline fit and has been confusing to maintenance personnel resulting in improper assembly. They experienced material spalling on the ball and the drive shaft. The ball is stellited. These parts were replaced. Packing is hard to perform with the valve in line, they can't see to repack it. They now use Grafoil and 1625 GF packing combination.

Plant 5 -- Bellows failures

Valves are 3-inch bellows stem seal air operated globe valves. This plant has a high spray control cycle situation and they have experienced bellows fatigue failures. They change out the bellows assembly at each refueling shutdown.

Plant 6 -- Packing leakage

Valves were originally conventional packed air operated globe valves. In February of 1973 these valves were backfitted with bellows seal bonnets. Problems since have not been experienced. They have a very stable spray condition; pressure is balanced by proportional pressurizer heaters, and the valves experience little movement.

Plant 7 -- Repairs

Valves are air operated bellows seal globes. The bellows seal cavity has a leak-off pipe attached for monitoring bellows failures. This is usually done with a pressure gauge. On one occasion, the connection to the gauge failed after the bellows failed and approximately 4000 gallons of reactor coolant leaked into containment. The original valves were backfitted with bellows in 1972.

Plant 8 -- Leakage and motor operator failure

The original valves were a motor operated bellows seal globe type. Fatigue failure of the bellows and motor failures led the utility to look for a better valve. They worked with a valve manufacturer to qualify a solenoid valve for this application. The solenoids have been in service for three years with no problem.

Appendix 3.2-A
Summary of ICE Components
Causing Plant Outages

3.2A-i/3.2A-ii

Appendix 3.2-A

Summary of ICE

Components Causing Plant Outages

Components/Systems Causing Plant Outages

<u>Component</u>		<u># Occurrences</u>
1. <u>Control Systems</u>		
Auto Control Problem (general/unspecified)		235
Electronic Components (unspecified)		17
Plant Test Transient not controlled		13
Pump/Turbine Speed Controls		10
Valve Control Malfunction		4
Auto/Manual Control Station		3
		<hr/> 282
2. <u>Personnel</u>		
Personnel Test/Maintenance/Calibration		117
Manual Control (Feedwater)		104
Operator error (misc. ICE)		59
		<hr/> 280
3. <u>Spurious</u>		
Spurious Control Action/Signal/EMI		132
Storms/Lightning		27
Valve Operator		5
Inverter Trips (EMI/Surge)		5
		<hr/> 169
4. <u>Sensor Channels</u>		
Nuclear Instrument Channel	18	23
Power Range Nuclear Detector	5	
Flow Transmitters	10	20
Flow Channel	10	
Level Channel	8	15
Level Switch	6	
Level Transmitter	1	
RTD Channel	12	12
Pressure Channel	5	11
Pressure Switch	5	
Pressure Transmitter	1	

Appendix 3.2-A (Continued)

<u>Component</u>	<u># Occurrences</u>
4. <u>Sensor Channels (Continued)</u>	
Sensing Line Problems	11
Moisture Detectors (RCP)	3
Incore Nuclear Instrument	2
Bearing Wear Detectors	2
Radiation Monitor Channel (Area)	2
Vibration Monitor Channel	2
Air Particulate Channel	1
Loose Parts Monitor Channel	1
Sensors (unspecified)	3
	<hr/>
	108
5. <u>Relays</u>	
Protective Relays (Electrical Distribution System)	33
Misc. Control	21
Reactor Protective System	6
Control Rod System	5
Turbine Generator Electrical Hydraulic Controls	3
Engineering Safeguards	3
Fast Transfer	1
	<hr/>
	72
6. <u>Motors</u>	
CRDM (Windings/Stator)	34
RCP (Oil System)	16
RCP (Electrical)	6
CSW Pump	2
T.G. Turning Gear	1
CRDM Clutch	2
CRDM Brake	1
	<hr/>
	62
7. <u>Power Supply</u>	
Control Power Circuit	21
CRS Internal Power Supply	15
TGS Internal Power Supply	7
Nuclear Instrument Internal Power Supply	5
Non-Nuclear Instrument Internal Power Supply	5
Voltage Regulator Internal Power Supply	1
Control Element Drive System Internal Power Supply	2
	<hr/>
	56

Appendix 3.2-A (Continued)

	<u>Component</u>	<u># Occurrences</u>
8.	<u>Bus</u>	
	Loss of Bus (unexplained)	43
	Grounds	<u>6</u>
		49
9.	<u>Transformers</u>	
	Main Transformer	31
	120 V Bus	3
	480 V Bus	1
	Current Transformer	1
	Feedback Transformer	2
	Differential Transformer	<u>1</u>
		39
10.	<u>Valve Operators</u>	
	Feedwater Regulation Valve	13
	Solenoids	16
	Motor Operator	4
	Pilot valve/motor	<u>3</u>
		36
11.	<u>Breaker</u>	
	Spurious opening or malfunction	13
	Spurious opening during test	8
	Faulty Contactor	5
	Wiring error	4
	Fast transfer failure	3
	Ground	1
	Internal Relay	<u>1</u>
		35
12.	<u>Fuse</u>	
	CRDM	15
	Reactor Coolant Pump	3
	Reactor Protective System	3
	Nuclear Instrument	2
	Inverter	3
	Feedwater Control System	1

Appendix 3.2-A (Continued)

<u>Component</u>	<u># Occurrences</u>
12. <u>Fuse</u> (Continued)	
Meter	1
Voltage Regulator	1
Sensor	1
Turbine Control System	1
Miscellaneous Control System	<u>3</u>
	34
13. <u>Inverter</u>	
Trip/Problem (unidentified)	27
Overcurrent Trip	<u>1</u>
	28
14. <u>CEA Position</u>	
Reedswitch Position Transmitter	17
Coil Failure	<u>1</u>
	18
15. <u>Generator</u>	
Loss Exciter	9
Ground	5
Winding Failure	<u>3</u>
	17
16. <u>Voltage Regulator</u>	
Voltage Regulator Malfunction (unidentified)	16
17. <u>Connections</u>	
Loose Terminations	8
Loose Printed Circuit Connector	1
Faulty Control Element Assembly	2
Containment Penetration	1
Replace Terminal Blocks	<u>3</u>
	15

Appendix 3.2-A (Continued)

<u>Component</u>	<u># Occurrences</u>
18. <u>Instrumentation (misc.)</u>	
Position Indicators (valves)	4
Potentiometer	1
Recorder	1
Thyristor	2
Indication Lamp	1
RPS Logic Matric	1
Control Room Communications	1
Unidentified	4
	<hr/> 15
19. <u>Capacitor</u>	
Reactor Coolant Pump	3
Inverter	4
Flow Transmitter	1
Reactor Protective System	1
Turbine Generator Electro Hydraulic Control	1
Feedwater Regulating Valve	2
Reactor Coolant System Control	1
Control Rod Power Supply	1
	<hr/> 14
20. <u>Switches</u>	
Manual Switch	8
Limit Switch	5
	<hr/> 13
21. <u>Cables/Wiring</u>	
Cable Fire	2
Cable Immersion	1
Wiring shorts/grounds	5
	<hr/> 8
22. <u>Bistable</u>	
Bistable failure (cause - unidentified)	6
Spurious	1
	<hr/> 7

Appendix 3.2-A (Continued)

	<u>Component</u>	<u># Occurrences</u>
23.	<u>Fans</u>	
	Head area fans	4
	Reactor Bldg. fans	2
	Generator Transformer fans	<u>1</u>
		7
24.	<u>Printer Circuit Card</u>	
	Miscellaneous	5
25.	<u>Battery</u>	
	Grounds	3
	Strap to cell resistance	<u>1</u>
		4
26.	<u>Diodes</u>	
	CEA Position Indication	1
	Generator Differential Trip Circuit	<u>1</u>
		2
27.	<u>Computer</u>	
	Multiplexor Inputs faulted	1

APPENDIX 3.2-B

TRIP REPORT #1

3.2-B-i/3.2-B-ii

APPENDIX 3.2-B
TRIP REPORT #1
PWR COMPONENT FAILURE STUDY -
VERIFICATION OF PWR SHUTDOWN DATA BASE
EVENTS BY A SITE VISIT

I. PURPOSE

The purpose of the site visit was to verify the information in the C-E PWR Shutdown Data Base. Discussions also included a review of any followup or corrective action taken to preclude the event from reoccurring.

The specific objectives of the trip were to confirm and discuss with the operating staff (plant engineers, operators and maintenance personnel) from the Instrumentation, Controls and Electrical (ICE) viewpoint the following plant specific items:

1. Review in detail for the systems selected each of the events in the data base to:
 - a. Verify that the event and subsequent entry into the data base was properly interpreted.
 - b. Determine the root cause of the disturbance. This may involve discussions and/or review of the equipment or system maintenance history.
2. Query the operating staff to determine if they agree with the order of ranking plant system disturbances by frequency and impact on plant safety or availability.
3. Determine if there are categories of non-reportable occurrences in the systems chosen.

The site chosen was a typical 800 MWe plant. It has been in commercial operation for approximately 2-1/2 years, with a representative sample of the types of occurrences found throughout the C-E PWR Shutdown Data Base.

II. RESULTS

A. Shutdown Data Base Verification

The forty-nine (49) specific occurrences identified in C-E's PWR Shutdown Data Base for the plant's Reactor Coolant, Control Rod, Condensate, Feedwater, Electrical Distribution, Main Steam and Turbine Generator Systems were reviewed. The review of the site's documentation and concurrent discussions with it's personnel resulted in clarifications and identification of root causes not readily discernible from the data base for fifteen (15) occurrences as identified in Table 3.2B-1. The remaining root causes were either already sufficiently identified in the data base or were found to be one same root cause for several outages in sequence.

For example all four occurrences for the Electrical Distribution System (EDS) in Table 3.2B-1 were due to the initial root cause. The main power transformer oil leak required several outages to repair and return to service.

B. Ranking of Plant Disturbances/Outages

1. System Ranking Survey

Site personnel were asked to rank the systems listed in Table 3.2A-2, as part of the verification process for selecting the systems which appear to be the major contributors to plant outages. The survey procedure utilized was to ask them to pick, in their opinion, the top 12 systems from the list with the most frequent problems/occurrences for their plant. They were then asked to

rank the 12 in order of importance to plant safety and plant availability. The data taken was reduced by weighting their rank 12 thru 1 in order of decreasing importance. The weighted values were then summed for each system. Table 3.2B-2 identifies the results for the top 8 ranked systems.

A benefit of choosing this method is that only events, having unresolved root causes, or of such severity that they were remembered by the operating staff were identified and evaluated.

The survey indicates, as expected, that the Main Feedwater System is of prime concern. Although only a relatively few cases have occurred for this plant, there is still a prime concern based on the potential failure modes and consequences.

The Chemical and Volume Control System (CVCS) appears to be ranked first for this plant in terms of safety impact. Although no direct plant outages have resulted, the high ranking in safety impact stems from:

- o Recent repairs to the charging pumps
- o Heat tracing temperature monitoring problems (concentrated boron piping) and
- o Abnormal valve lineup necessary when concurrently diluting RCS boron concentration and making up (adding) to the Volume Control Tank.

Ranked second on plant availability is the Turbine Generator System, which is in general agreement with the data base review. This plant has experienced relatively few events. Its few problems have been with the turbine controls and generator bearing or coolant system.

With the exception of one control problem the staff seemed quite satisfied with the EHC computer controlled logic.

Even though there were no outages attributable to the occurrence of Auxiliary Feedwater System events, it was ranked third. The most probable reason for this rank is the recent loss of auxiliary feedwater incident at the Three Mile Island - 2 Nuclear Station.

The Condenser System availability ranking of third is probably due to the plant's previous problem with condenser tube leaks and the degree of difficulty in locating them. Although the problem appears to be resolved by retubing the condensor with titanium, improved monitoring for tube leaks is still desired.

Although the Circulating and Saltwater System was ranked fourth in both safety and plant availability impact, there is only one manually controlled plant shutdown for maintenance in the data base. Concerns were expressed that the system's capacity was strained when operating at full capacity under normal full power operating conditions. There was also some concern for the degree of redundancy required for this heat sink when in the decay heat removal mode of operation during major equipment maintenance outages. This is further complicated by maintenance on the shutdown cooling system during the same time period as evidenced by its ranking of sixth from the safety impact viewpoint.

The Control Rod System ranking of 4 and 5 respectively for safety and availability impact is due to unexplained dropped rods or dropped rods due to loss of a power supply (motor, generator or internal supply in the control system).

No clear reason was established for the low rankings of the Component Cooling Water and Reactor Coolant Systems.

2. Review of Summary of ICE Related Plant Outages

A summary of plant outages (Tables 3.2B-3 & 3.2B-4) previously prepared from the C-E data base was reviewed with the site personnel to gain their opinion on that effort.

The personnel did not express any overwhelming opinions. Only general agreement was voiced in that the tabulation did not appear to be unreasonable. There was no reason to dispute it and to some personnel it was informative.

C. Determination of Existence of Non-Reportable Occurrences

The review did verify that a high frequency of events or unreportable occurrences does not exist for the systems being considered. Nor were any additional frequent component problems or occurrences uncovered which could be construed as "near-misses" in terms of causing plant outages.

D. Miscellaneous Staff Comments

During the various discussions, the staff made the following noteworthy comments:

1. Application of a "Disturbance Analysis System" - During the review of the Feedwater System outages, the personnel thought the use of a Disturbance Analysis System (DAS) would aid the operator in early detection of component failures with the result that more time would be available for corrective action. The DAS is a system presently being developed under an EPRI/C-E contract. Refer to EPRI NP-613 Project RP891 Interim Report Feb. 1978, "On-Line Power Plant Alarm and Disturbance Analysis System", for a further description of this system.

2. Turbine Generator System - Turbine megawatts and its rate of change should be continuously monitored as an indication of a perturbation in the secondary system. Most significant outages or equipment malfunctions can be detected by a change of 20 megawatts or more. This would detect problems, such as TG Control valve oscillations, loss of condensor vacuum, gland seal leaks, single intercept valve closures, etc., which would go unnoticed until it's too late to correct. Monitoring the turbine electro-hydraulic control (EHC) system and auto stop header pressures could predict impending turbine trips due to low hydraulic pressure. The Main Steam Reheater outlet temperature to the low pressure turbines should be continuously monitored to prevent long term turbine blading stresses due to uneven heating effects. This site presently has only a single point recorder, which is used to monitor the temperature by manually selecting the temperature input desired. Temperature imbalances could go undetected for hours or days depending upon the personnel's vigilance.
3. Main Feedwater and Reactor Coolant Pumps - Monitoring of major pump parameters such as cooling water; lube oil temperature, level, or pressure; vibration, etc. may provide additional lead time for operator corrective action such as power reduction, starting of standby pumps, etc.
4. Post Scram or Accident Monitoring System - They would like a system to provide operator assistance not only in preventing an outage like the DAS, but also following a major plant upset; such as a reactor trip. The system should be able to sort out the nuisance (less important) alarms. They also expressed the concern for accurately programming all the possible plant configurations prior to and following a plant trip. Based on this, they felt the system should provide an overview type of guidance rather than detailed guidance following a plant trip or design basis event. For example, an NSSS primary to secondary system heat

imbalance could be identified, but let the operator decide exactly how to re-establish the heat balance on the existing system configuration.

The system should help in preventing abnormal plant lineups from causing unwarranted outages or violations of plant technical specifications for systems required to be operational. For example, during the site visit, maintenance was being performed on a feedwater heater because of a tube leak. A loss of condenser vacuum due to a misalignment of a valve associated with the out of service heater went unnoticed by plant operators and a turbine trip on high condenser back pressure was narrowly averted.

5. Feedwater System - The site has experienced some main feed pump trips believed to be caused by low suction pressure when testing and restarting the pumps. They have installed a ten second time delay on the pump's low flow trip relay. This has apparently improved its ride through capability during the transient.

Manual feedwater control was considered to be difficult at low power as is typical for most PWRs. The plant is currently involved in a test program for an Extended Range Feedwater Control System prototype.

6. Instrument Power Invertors - The installation of cooling fans on their invertors has improved their performance.
7. Reactor Coolant Pumps - When asked if they had any significant problems concerning the pump seals or lube oil systems, they only mentioned noticing changes in lube oil level as a function of containment pressure. This was deemed not to be a problem. This verifies the data base's lack of plant outages due to RCPs.

8. Reactor Coolant System - Some personnel still believe the pressurizer relief valve leakage problem exists and is due to an hydrogen chemical reaction attacking the valve seats.
9. Nuclear plant secondary steam systems do not seem as reliable as the higher pressure fossil plant steam systems. Nuclear plants appear to have more feed system and turbine problems than fossil plants.
10. The comment was made that the NSSS supplier should make available an on-site representative. The philosophy behind the comment was that first hand information and a better understanding of operational related equipment problems could be fed back to the equipment designers. As it stands today, the designer only hears about problems if the utility staff can't resolve a major problem. All the average or minor occurrences are either lived with and carried on from plant to plant or are resolved without the equipment designer ever knowing a change has been made to his system. The site representative would be the needed missing link to provide feedback to the designer.

III. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on the information gained from the site visit and the verification effort as a whole to date.

1. The data input to C-E's Shutdown Data Base needs improvement if it is to be continued to be utilized as information input for the engineering analysis and resulting corrective action. The data is not detailed enough to pinpoint root causes and the sequence of events leading to the shutdown. Additional site visits should be made to verify root causes and determine how the utility and manufacturer can best interface to resolve the recurring events.

2. The plant personnel are in general agreement with the selection of the systems/components to be studied.

The personnel's ranking of systems on impact on plant safety identified 4 of the 7 that were picked by reviewing the data base. The site survey did indicate that the Main Circulating and Saltwater; Component Cooling Water and Shutdown Cooling might be included in the top 7.

Ranking the systems occurrences based on impact to plant availability showed agreement on 5 out of the 7 chosen for review. The Main Circulating and Saltwater system and Component Cooling Water System were also identified as potential candidates.

3. Site personnel seemed fairly well satisfied with the I&CE portions of the systems reviewed and were quite pleased with their maintenance staff's ability. This supports the data base review conclusion, that this plant has exhibited only a minimal amount of outages due to ICE equipment.
4. Several instances of ICE occurrences were attributed to non-seismic vibration and shock on non-safety grade control equipment. Perhaps consideration should be given for adding more stringent requirements into equipment specifications. The effort would entail obtaining inplant vibration data in order to develop generic vibration frequency response curves.

Another approach would be to perform an on-site shock and vibrations survey throughout the plant as part of its initial start-up test program. The baseline data could then be used for inservice inspection purposes during the life of the plant. Potential equipment failures could then be predicted and remedied during a convenient outage, rather than forcing an immediate outage if it had gone unnoticed.

5. Further efforts should be performed to validate and pursue the concept of monitoring the Main Steam Reheater effects on the Turbine Generator as described above in Section D.2.

TABLE 3.2B-1

SITE - I SHUTDOWN DATA BASE
(with expanded descriptions and corrections due to
site visit in non-computer print)

<u>Date</u>	<u>S/D Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>
SYSTEM IS CONDENSER SYSTEM					
77 124	PR	-0.0	CDS	PUMPXX	CLEAN CONDENSATE PUMP SUCT. STRAINERS
SYSTEM IS CONTROL ROD SYSTEM, RODS, DRIVES, CONTROLS					
78 113	AS	3.7	CRS	CRDRVE	UNT TRP REAL PROTEC SYS BY RPD INSERT OF CEA Rod drop of high worth rod caused about a 15% power reduction (unit had turbine runback disabled), reactor power increase due to load following tripped system on variable high power trip before operator could reset setpoints.
77 6 7	AS	3.8	CRS	PWRSUP Operator	LOSS 2ND OF 2 ROD COTRL SYS P/S, PROB ROD DROP A motor-generator (MG) failed in service, Operator went to isolate failed MG and opened breakers for operating MG.
77 527	PR	0.0	CRS	UNKNWN	RUNBACK C/R CROPPED CEA Lost FWP during turbine runback for unknown reason.
77 901	PR	0.0	CRS	UNKNOWN	Runback C/B Dropped CEA, during CEA test - (changed procedure for future use).
SYSTEM IS ELECTRICAL DISTRIBUTION SYSTEM					
78 829	MC	6.4	EDS	TRANSF	RPR OIL LK IN MAIN POWER XFRMR FO
78 830	PH	-0.0	EDS	TRANSF	LOAD LMTD BY CAPAC OF MAIN XFRMR SH
78 831	NS	2.9	EDS	TRANSF	UNIT OFF-PROTECT PERS. REMOV XFRMR BUSING SO
78 9 2	NS	6.4	EDS	TRANSF	UNT FRM SERV, RTRN MAIN XFRMR TO SERV SO Same root cause - high temp. & pressure in oil system for main transformer busing caused oil sight glass to leak - repairs were performed during 4 day period.

TABLE 3.2B-1 (Continued)

Date	S/D Method	Duration	System	Component	Description	
7 221	AS	2.8	FWS	CONTRL	SG LO LVL DUR LOAD INCRS AFTR planned manual TURB TRIP	
77 430	MS	4.6	FWS	CONTRL	TRANS CONDIT C/B HTR DRN PUMP CNTRL MANLFUNC - Drain tank pump control valve fast closure caused water hammer which shocked pipe into a wall on which RCP bus breakers were located, reactor was tripped manually before the low RC flow trip.	
78 129	NS	.3	FWS	CONTRL	SG LVL TRANS DUR LOAD INCRES AFT OUTAGE	SG level transient during
78 6 3	NS	.2	FWS	CONTRL	HI LVL IN SG DUR LOAD INCR ON UNIT SU	manual control
77 3 5	PR	-0.0	FWS	FILTER	PR-CLEAN COND PUMP SUC STRAINERS	
77 830	PR	-0.0	FWS	FILTER	CLN FWP SUC STRAINR 1N4 304DENSOR, PR-65PC	
771117	PR	0.0	FWS	FILTER	LD WS RED CLN STM GEN FDWTR PMP SUC STRNR	
78 2 8	PR	-0.0	FWS	FILTER	CLN FWP SUC STRAINRS	
78 822	PR	-0.0	FWS	FILTER	CLN FWPIB SUC STRNR	SR
7810 2	PR	-0.0	FWS	FILTER	PR-CLN COND PMP 1B SUC STRNR	FR
78 610	PR	-0.0	FWS	MECFUN	LR,BAL FWP-1B, RALIGN PUMP-MTR COUPLING	
77 1 3	AS	44.8	FWS	PUMPXX	LOSS OF SG FEED PUMPS, LOFW, PERFORM MAINT Operating FWP tripped during start-up of the second FWP	
77 831	AS	3.6	FWS	PUMPXX	LOSS OF THE OP FWP (AT 65PC) SEV CEA DROP ON SU - Second FWP started at 65%, causing a rapid SG level increase, the subsequent FW flow reduction caused both FWP's to trip	
771122	AS	3.9	FWS	RELAYXI	FWP TRIP, FWP FLO PROTECT RLAY ACTUATE - I, Flow relay actuated when bumped by a construction worker.	
77 625	AS	14.6	FWS	XJOINT	FWP TRP C/B FLD COND SYS XPANS JOINT, LO LVL	
SYSTEM IS MAIN STEAM SYSTEM						
781028	MC	311.3	MSS	HTEXCH	SCHED SG TUBE INSPEC PROG	SO

3.2B-12

TABLE 3.2B-1 (Continued)

<u>Date</u>	<u>S/D Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>
SYSTEM IS REACTOR COOLANT SYSTEM					
78 123	MC	57.3	RCS	GASKET	UNT RMVD FRM SVC RPLC GSKT PRZR MNWY CLSR
77 510	MC	63.5	RCS	UNKNWN PIPE	RPR NON-ISOL LK INSIDE CNTMNT - SIT tank gage line non-insolatable leak
77 628	NS	13.1	RCS	VALVEX	RPR PACK LK, prz. VLV INSIDE CNTMT, NON-ISOLABLE
77 7 4	NS	8.1	RCS	VALVEX	RPR PACK LK PZR SPRAY VLV
77 7 8	MC	11.0	RCS	VALVEX	RPR FLD PZR SPRAY VLVS
77 710	NS	10.1	RCS	VALVEX	MNT ON PZR SPRAY VLV
77 712	NS	8.1	RCS	VALVEX	INSTAL RPRD ALT PZR SPRAY VLV
77 729	NS	17.2	RCS	VALVEX	INSTAL MOD PZR SPRAY VLV ASSY
781214	MC	64.2	RCS	VESSEL	UNIT FROM SERV, RPLC FLO PZR MANWAY GASKET F0
SYSTEM IS TURBINE GENERATOR SYSTEM					
78 810	AS	7.5	TGS	CONTRL	TRANS C/B MALFUNC TGS CNTRL DUR TGS VLV TST F0 During transfer of turbine valves from sequential valve opening to single valve a swing in megawatts caused a high pressurizer pressure trip.
77 6 5	NS	3.5	TGS	EXCITR	BAL TURB/GEN XCTR
77 6 5	NS	3.4	TGS	EXCITR	BAL TURB/GEN XCTR
77 6 5	NS	3.1	TGS	EXCITR	BAL TURB/GEN XCTR Balance turb-gen after outage 5/31/77 for turbine permanent magnet replacement.
77 4 3	MS	200.0	TGS	GENERA	FIRE NEAR GEN MAIN LEAD BOX - Vibration in lead box caused hydrogen leak
78 6 3	NS	12.7	TGS	PIPEXX	LOC AND RPR HYDOGN LK
78 129	AS	9.0	TGS	PWRSUP	UNT WS TRPD LS FLD RLA INTRMT LS P/S, VOLT REG
78 129	AS	7.2	TGS	PWRSUP	LS PWR SPLY GEN VOLT REG UNT TRP LS FLD RLAY
78 129	AS	7.7	TGS	PWRSUP	LS PWR SPLY GEN VOLT REG UNT TRP LS FLD RLAY
78 131	AS	5.4	TGS	PWRSUP	LS PWR SPLY GEN VOLT REG UNT TRP LS FLD RLAY Problem with instrument fuse contacts

TABLE 3.2B-1 (Continued)

<u>Date</u>	<u>S/D Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>
77 531	AS	110.6	TGS	RELAYX	LOSS FIELD RELAY ACTUAT. RPLC GEN XCITR COMP Circulating currents caused by a short to ground caused bearing wear.
771220	AS	10.5	TGS	RELAYX	UNT TRPD, ACTUA OF LS FLD RLAY fuse problem
78 6 1	AS	3.0	TGS	TESTXX	TEST TURB OVERSPEED TRIP DEVICE Normal test
78 6 5	NS	8.3	TGS	TURBIN	BAL TURBIN/GEN

SHUTDOWN METHODS

AS Automatic Scram
CO Continuation of Prior Outage
MC Manual Controlled Shutdown
MS Manual Scram
NS Generator Off-Line, Reactor Critical
PH Power Hold Below Full Power
PI Spurious or Unplanned Power Increase
PR Power Reduction

FO Forced Outage
SO Scheduled Outage
FR Forced Reduction
SR Scheduled Reduction
SH Scheduled Power Hold
C/B Caused By

TABLE 3.2B-2

<u>Major Plant System/Component</u>	<u>RANKING OF OCCURRENCES</u>	
	<u>Impacting Plant Safety</u>	<u>Impacting Plant Availability</u>
Auxiliary Feedwater System	3	
Area Radiation Monitoring		
Boric Acid Injection System		
Chemical and Volume Control System	1	6
Compressed Air System		
Component Cooling Water System	7	8
Condensor System		3
Containment Isolation System		
Containment System		
Communications System		
Reactor Core/Fuel/Vessel		
Control Rod System	4	5
Circulating and Saltwater System	4	4
Cooling Tower System		
Demineralized Water System		
Emergency Diesel Generators		
Electrical Distribution System (Grid)		
Emergency Core Cooling System		
Main Feedwater System	2	1
Main Steam System		
Process Instrumentation		
Nuclear Instrumentation		
Natural Phenom/External Causes		
On-Site Power System		
Personnel		
Plant Computer		
Reactor Coolant Pumps		
Reactor Coolant System	5	7

TABLE 3.2B-2 (Continued)

<u>Major Plant System/Component</u>	<u>RANKING OF OCCURRENCES</u>	
	<u>Impacting Plant Safety</u>	<u>Impacting Plant Availability</u>
Reactor Protection System	-	
Reactor Regulating System		
CEA Position Indicating System		
Sampling System		
Shutdown Cooling System	6	
Turbine Generator System	8	2
Waste Management System		

The top 8 systems ranked by system (1 thru 8) in decreasing order of importance for each of the three columns, based on survey of 5 site personnel.

TABLE 3.2B-3

SUMMARY OF PLANT OUTAGES INVESTIGATED

Number of Plants: 40 PWR
Number of Vendors: 3 (Westinghouse, C-E and B&W)
Over Period of: 26 Months (10-1-76 to 12-31-78)⁽¹⁾

<u>Plant Subsystem/Reason Causing Outage</u>	<u>Number of Outages</u>	<u>Number of Outages Due to ICE Related Equipment</u>	<u>Outages/ Plant Year</u>
Feedwater System	218	182	2.25
Turbine Generator System	269	112	1.34
On-Site Power System	55	57	.70
Control Rod System	62	48	.60
Reactor Coolant Pump	74	40	.49
Reactor Coolant System	64	24	.30
Main Steam System	<u>78</u>	<u>20</u>	<u>.24</u>
Totals	820	483	5.92

Note:

1. Base is 80.5 plant years of PWR Commercial Operation

TABLE 3.2B-4

CATEGORIZATION OF ICE SYSTEM/COMPONENT
DISTURBANCES

- o Number of Plants: 40 PWR
 - o Number of Vendors: 3 (Westinghouse, C-E and B&W)
 - o Over Period of: 26 Months (10-1-76 to 12-31-78)⁽¹⁾
-

<u>SYSTEM</u>	<u>ICE OCCURRENCES IN OPERATING PLANTS</u>	<u>AVG. OCCURRENCES PER PLANT YEAR</u>
<u>FEEDWATER SYSTEM</u>		
o Sensors	6	.07
o Control System	12	.15
o Actuated Devices		
Pumps	64	.79
Valves	30	.37
o Personnel Related	70	.87
<u>TURBINE GENERATOR</u>		
o Elect. - Hydr. Control System	33	.39
o Trips During Testing	29	.34
o Voltage Regulator	21	.26
o Generator	19	.23
o Gov./Intercept Valves	10	.11
<u>ON-SITE POWER SYSTEM</u>		
o Inverter	17	.20
o Vital Bus	8	.10
o RCP Bus	11	.13
o Personnel Related	7	.09
o Instr. Bus	4	.05
o Battery Bus	5	.06
o Misc. I&CE	5	.06

TABLE 3.2B-4 (Continued)
CATEGORIZATION OF ICE SYSTEM/COMPONENT
DISTURBANCES

<u>SYSTEM</u>	<u>ICE OCCURRENCES IN OPERATING PLANTS</u>	<u>AVG. OCCURRENCES PER PLANT YEAR</u>
<u>CONTROL ROD SYSTEM</u>		
o CRDM Motor	18	.22
o Power Supply	13	.16
o Wiring/Cabling/Terminations	8	.10
o Fuse	7	.09
o Relay	1	.01
o Head Area Cooling	1	.01
<u>MAIN STEAM SYSTEM</u>		
o MSIV Control CKT	5	.06
o MSIV Solenoid	4	.05
o Unexplained MSIV Closure	3	.04
o Operator Close MSIV	2	.02
o Sensors	5	.06
o MSIV Motor	1	.01
<u>REACTOR COOLANT SYSTEM</u>		
o Loop Flow Transmitter	12	.15
o Pressurizer Press. Transmitter	4	.05
o Loose Parts Monitor	3	.04
o Pressurizer Spray Valve	3	.04
o Pressurizer Level Transmitter	1	.01
o RTD	1	.01
<u>REACTOR COOLANT PUMP</u>		
o Lo Motor Oil Bearing Level	27	.34
o Seal Sensing Line	5	.06
o Motor Surge Capacitor	2	.02
o Misc. ICE	3	.04

TABLE 3.2B-4 (Continued)
 CATEGORIZATION OF ICE SYSTEM/COMPONENT
DISTURBANCES

<u>SYSTEM</u>	<u>ICE OCCURRENCES IN OPERATING PLANTS</u>	<u>AVG. OCCURRENCES PER PLANT YEAR</u>
<u>REACTOR COOLANT PUMP (Continued)</u>		
o Motor Failure	1	.01
o Unexplained Trip	1	.01
o Personnel Related	1	.01

NOTE:

1. Base is 80.5 plant years of PWR commercial operation

APPENDIX 3.2-C

SITE VISIT REPORT #3

3.2-C-i/3.2-C-ii

APPENDIX 3.2-C
TRIP REPORT #2
PWR COMPONENT FAILURE STUDY -
VERIFICATION OF PWR SHUTDOWN DATA BASE
SITE VISIT

I. PURPOSE

The purpose of the site visit was to verify the information in the C-E PWR Shutdown Data Base. Discussions also included a review of any follow-up or corrective action taken to preclude the event from reoccurring.

The specific objectives of the trip were to confirm and discuss with the operating staff (plant engineers, operators and maintenance personnel) from the Instrumentation, Controls and Electrical (ICE) viewpoint the following plant specific items:

1. Review in detail for the systems selected each of the events in the data base to:
 - a. Verify that the event and subsequent entry into the data base was properly interpreted.
 - b. Determine the root cause of the disturbance. This may involve discussions and/or review of the equipment or system maintenance history.
2. Query the operating staff to determine if they agree with the order of ranking plant system disturbances by frequency and impact on plant safety or availability.
3. Determine if there are categories of non-reportable occurrences in the system chosen.

The site chosen had three typical 800 MWe plants. They had a combined total of 12 years of commercial operation with a representative sample of the types of occurrences reported by plants designed by the NSSS vendor for these plants.

II. RESULTS

A. Shutdown Data Base Verification

The sixty-three (63) specific occurrences identified in C-E's PWR Shutdown Data Base for the plant's Reactor Coolant, Control Rod, Condensate, Feedwater, Electrical Distribution, Main Steam and Turbine Generator Systems were reviewed. The review of site documentation and limited discussions with personnel resulted in clarifications and identification of root causes not readily discernible from the data base for thirty-nine (39) occurrences as identified in Table 1. The root causes for remaining occurrences were either already sufficiently identified in the data base or were not found due to insufficient documentation and discussion with the operating staff.

B. Summary of Informal Discussions and Opinions on Questions Raised During Data Base Review

The following questions/answers are based on limited informal discussions with a limited number of site personnel and should be viewed accordingly.

1. QUESTION: What's the status of CEDM stator failures?
ANSWER: Problem only seems to occur when plant shuts down for maintenance/refueling. NSSS vendor has recommended purging with nitrogen to keep the coils dry. This appears to be working on other similar plants but is difficult, expensive and a nuisance to implement.

QUESTION: Is there a relationship between the coil failures and their respective power supply problems (i.e. blown fuses, diodes, etc.)?

ANSWER: There appears to be no such correlation.

2. QUESTION: Has the time delay for the loss of 125 Vdc turbine trip in the EHC system helped?

ANSWER: The change has been too recent to make any conclusions.

QUESTION: Has the reason for the momentary losses of power been determined?

ANSWER: Not yet.

3. QUESTION: Is there an actual RCP oil level problem or is it false indication?

ANSWER: The oil is actually leaking out. The pumps reservoir is being filled above its normal level to permit longer intervals between refills.

4. QUESTION: The data base contains outages due to flux/flow imbalances. The review of the plant trip reports show these occur at or near full power operation and appear to be due to operating within the error margins to trip. What is primary contributor?

ANSWER: Spurious small transient occurring on the RC flow channels and difference in core power distribution due to differences in Reactor Inlet appear to be the suspected contributor. The NSSS vendor has recommended keeping the electronics tuned/calibrated better. The operators experience is also a factor in how close the plant can operate to the setpoints.

5. QUESTION: What is status of pressurizer spray valve leakage problem?

ANSWER: The electric motor operated valves were replaced approximately 2 years ago with "Target Rock" solenoid operated

valves. The leakage problem has been resolved and the valves performance considered to be excellent.

6. The opinion was made that better steam extraction valves to the heaters should be considered. They are difficult to get open because of the differential pressure across them. The use of bypass valves was suggested.

7. QUESTION: What type of control problems do you have with the feedwater pumps?

ANSWER: Not many, operators are aware of the pitfalls, such as ensuring the one being brought on-line is sufficiently loaded prior to taking the other one off-line.

QUESTION: Do you have any vibration problem with the FW pumps?

ANSWER: No.

QUESTION: Any problems with oil pumps?

ANSWER: Yes, do not start auxiliary oil pump when shaft driven pump is operating because a low oil pressure transient trip may occur. They agreed that the addition of a time delay may help.

8. QUESTION: How is maintenance scheduled?

ANSWER: Usually as required. They are attempting to start a computerized program for preventative maintenance. Details were not available.

QUESTION: How is information transmitted to others?

ANSWER: At weekly staff meetings. It was their opinion that the Utilities Engineering Staff responses to their problems/concerns was somewhat less than optimal.

9. QUESTION: Are significant problems encountered when controlling feedwater flow in manual at low power levels (15%)? High power levels? Do steam generator levels fluctuate over a wide range?

ANSWER: Control at low power levels is tricky, but the operators are well aware of it and are trained to stay on top of it. They have enough leakage past the blocked feedwater control valves, that they can control it manually thru the bypass valves. No problems at high power. Normal level fluctuations are $\pm 5\%$. They had an 8% oscillation problem during slow transient which has been corrected.

10. QUESTION: When compared with other PWR designs, this plant experiences fewer reactor trips associated with fluid instabilities in the condensate and feedwater systems? Is this because no trip is associated with high or low steam generator levels? If a reactor trip was originated by steam generator level, would the number of trips increase?

ANSWER: They now have a high level turbine trip, which in turn trips the reactor. It was their opinion that the number of trips would not be influenced.

11. QUESTION: What are the functions of the 72,000 gallon upper surge tank? Is the NPSH of the condensate booster pumps aided or provided by the tank?

ANSWER: The tank only provides a source for the hotwell and doesn't really help the booster pumps NPSH. This is mainly due to the demineralizer system being in series.

12. QUESTION: Would the use of MFP trip time delays, MFP selective tripping, or surge tank(s) to provide NPSH to the main feed, condensate, or condensate booster pumps minimize any feed flow or control problems that are experienced?

ANSWER: This plant has variable speed turbine driven FW pumps. As such, they are able to prevent problems with low suction, using suitable pump operating procedures for pump start-up and transfers. The majority of problems is due to the operators learning curve.

C. Observations and Conclusions

1. The review of the plant trip reports confirms the suspicion that a fair number of plant outages are caused by multiple failures. The plants seem to be resistant to single failures due to system designs and operator corrective action. It may be useful to compare the number of LERs vs. number of trips on a system by system basis. The review of such data would identify where efforts should be spent/concentrated in redesigning systems to meet multiple failure criteria. It would also provide a basis for the type of events and equipment failures which must be included in the failure criteria.
2. The visit would have been more fruitful if sufficient opportunity to discuss the plant outages and their root causes with the operating staff was possible.
3. The System Ranking Summation Table 3.2C-2, indicates agreement with the study that the Feedwater System and Control Rod System are considered among the top contributors to plant outages.

TABLE 3.2C-1

SITE-2 SHUTDOWN DATA BASE
(with corrections due to site visit
in non-computer print)

Date	S/D Method	Duration	System	Component	Description	
SYSTEM IS CONTROL ROD SYSTEM, RODS, DRIVES, CONTROLS						
761027	AS	10.5	CRS	PWRSUP	CRD <u>phase firing</u> POWR SUP MALFUNC SUR TST	
77 125	CO	20.8		INSTRU	RPLAC CON ROD PI TUBE, FLD DUR STARTUP	
77 2 1	MS	169.5	CRS	HOUSIN	RPAIR CRDN CLOS ASSY LK, RPLAC CRDM PWR CABLES	
78 8 3	CO	42.1	CRS	CRDRVE	RPLACE STATOR ROD 10, GRP 1	F
78 825	PR	-0.0	CRS	CRDRVE	CR 1, GAP 7 DRPD-STATOR PROB	F
78 9 1	PR	-0.0	CRS	CRDRVE	ROD 1, GRP 7 DRP-STATOR PROB <u>[Phases shorted]</u>	F
781023	MC	34.2	CRS	CRDRVE	SHORTED CRD STATOR, ROD 3, GRP 6	F
761021	PR	-0.0	CRS	FUSEXX	REPLACE FUSE ON CRS	
				<u>Operator</u>	<u>Operator pulled fuse trouble shooting CEA position indication with</u>	
					<u>CRS in auto</u>	
761227	MS	13.7	CRS	RELAYX	CRDRVE POWER SUPPLY RELAY FL. PROB ROD DROP	
					<u>Due to incipient failures (relays, fuse, diodes) in phase firing</u>	
					<u>circuits prior to test</u>	
77 323	AS	7.3	CRS	CONTRL	ROD DROP DUR ROD MOVE TEST	
77 919	CO	47.6	CRS	CRORVE	RPLAC STATOR ON CR DRIVE	
77 921	CO	33.9	CRS	CRDRVE	RPLAC STATOR ON CR DRIVE	
77 923	CO	31.9	CRS	CRDRVE	RPLAC STATOR ON CR DRIVE	
771229	MC	181.3	CRS	STATOR	CR DROP, RPLAC STATOR, CR4, GRP6	
78 131	AS	6.9	CRS	FUSEXX	TRPD <u>due to</u> CNTRL RD DRVE <u>phase</u> FS FLR	
78 3 1	PR	-0.0	CRS	CRDRVE	PWR FL-CRD GRP S DUR MOVE, RODS PARTIAL INTO CO	
78 620	PR	-0.0	CRS	TESTXX	CRD MOVE TST, DETRM PERFRM-CR6, GRP4	
78 7 1	MC	107.8	CRS	CRDRVE	RPLAC STATOR ON CR6-GRP4	
78 923	PR	-0.0	CRS	TESTXX	PR-SOPC PT/0/600/17/, WITHDRAW GRP 7 RODS	S
7810 4	PR	-0.0	CRS	CRDRVE	ROD 7, GRP 6 INOP, PR TO 70PC	F
781019	PH	-0.0	CRS	CRDRVE	ROD 7, GRP 6 INOP, PH AT 59PC	F
781031	PH	-0.0	CRS	CRDRVE	PH AT 55 PC, ROD 7 STILL INOP	F
761111	MC	40.1	CRS	CRDRVE	RPLAC FLO CRD STATOR	
77 820	MC	35.6	CRS	CRDRVE	SHRT IN CRD STATOR, ROD DROP	
7712 6	NS	151.6	CRS	CRDRVE	CR3 GRP8 RECOUPLD, PROB ROD DROP	

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TABLE 3.2C-1 (Continued)

<u>Date</u>	<u>S/D Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>
SYSTEM IS CONDENSER SYSTEM					
7610 9	PR	-0.0	CDS	PUMPXX	HI BEARING OIL TEMP IN HOTWELL PUMPS Due to flooding in basement from adjacent plant, water got into oil sump. Root cause was instrument bus inverter failure during maintenance on condenser causing repositioning of valves to cause flooding.
77 524	AS	4.3	CDS	VALVEX	LOST COND VAC DUE TO FLD VLV DUR EFW PUMP TST Unseated check or relief valve, changed TST procedure to prevent shifting pump stem discharge from atmosphere to condenser for EFW pump.
781121	PH	-0.0	CDS	UNKNWN	PH, 6 DAYS, 97 PC, LOW COND VAC F
781225	AS	13.6	CDS	UNKNWN	RX-PWR IMBAL, C/B LOSS COND VAC F
				Gasket	Operator isolated upper surge tank to find source of vacuum leak. The leak was in the tanks man way gasket. Upon reopening the valves, a condenser loss of vacuum occurred.
78 2 9	PR	-0.0	CDS	HTEXCH	CONDENS TUBE LK
SYSTEM IS MAIN FEEDWATER SYSTEM					
77 4 3	AS	2.5	FWS	CONTRL	F1 IN ICS FW CONTRL MOD CIR "B" loop feed flow summer failed, causing FWCV to open and drop Tave. Operator took manual FW control and over adjusted the sensitive Tave. potentiometer control.
771018	AS	8.9	FWS	PUMPXX Operator	LOSS OF FWP A CAUS RX During S/U @ 15% shifting FWCV to "auto" caused MFP low suction pressure transient, because condensate booster pumps were not in "auto".
78 312	PR	-0.0	FWS	PUMPXX	CHANG PACKING IN HTR DRN PMP 1-D-2
78 316	PR	-0.0	FWS	PUMPXX	PACKING PROB, HTR DRN PMP 1-D-2
78 417	PR	-0.0	FWS	PUMPXX	PACKING MNT ON HTR DRN PMP BD-2

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TABLE 3.2C-1 (Continued)

Date	S/D Method	Duration	System	Component	Description
78 530	PR	-0.0	FWS	PUMPXX	HI COND FLO, 1E2 HPD OUT-SERV, ABNORM LK FRM DRN
7610 3	PR	-0.0	FWS	PIPEXX	REPAIR OF CASING VENT LINE ON FWP
761012	PR	-0.0	FWS	PUMPXX	LOSS OF OIL TO FW PUMP BEARING
78 2 1	PH	-0.0	FWS	PUMPXX	RPR 1K FWP 2A GASKET
78 2 1	PH	-0.0	FWS	PUMPXX	RPR FWP 2B VLV
78 218	PR	-0.0	FWS	PUMPXX	UNSPEC PROB, 201 HTR DRN PMP
78 5 4	AS	3.0	FWS	VALVEX	VLV 2HD-28 FLO DUR MSR DRN TST ← Valve stem broken
78 7 1	PR	-0.0	FWS	VALVEX	RPAIR FWP A DRN VLV
781030	AS	15.6	FWS	PUMPXX	FWP 2B TRP, CAUS UNIT TRIP
781030	AS		FWS	OPERA	"A" FWP inoperable, "B" FWP tripped by welding fire.
770821	AS		FWS	OPERA	Improper FWP transfer causes transient and pump trip
					S/U @ 15% shift to auto, FWCV transient caused Hi PZR press trip
					due to spray valve being throttled. (turb failed to trip due
					to loose wire)
77 822	PH	-0.0	FWS	PUMPXX	FWP TURB TRIP C/U. PH AT 57 PC F
77 825	PR	-0.0	FWS	PUMPXX	FWP TURB TRIP, C/U. PR TO 60 PC F
78 825	AS	3.0	FWS	CONTROL	SWING IN FWS CAUS FLX/FLO IMBAL RX
				Unknown	< @ 100% FWP low suct. alarm
781025	PR	-0.0	FWS	PUMPXX	FWP 38 TR1, RUNBACK TO 66PC F
78 113	AS		FWS	CONTROL	FWP "A" trip C/B EHC problem during load reduction @ 44%
7811 4	PH	-0.0	FWS	VALVEX	PH-50PC, RPR LK ON 3FDW-251, HI PNT BLK VLV F
7811 5	PR	-0.0	FWS	CONTRL	FW/REACT LIM MISMATCH CAUS PR TO 82PC F
7811 7	AS	14.9	FWS	INSTRU	SWING IN FW SYS CAUS TT RX
					C/B "A" MFP EHC problem
781211	MC	158.3	FWS	VALVEX	RPR LK, FW LINE SUP LINE CHK VLV 3-FDW-46 F
SYSTEM IS MAIN STEAM SYSTEM					
761031	MC	368.3	MSS	HTEXCH	RPAIR SG 1A TUBE LK
7612 8	MC	287.5	MSS	HTEXCH	OTSG 1B TUBE LK, 4GPM
77 115	MC	222.2	MSS	HTEXCH	OTSGG 1B TUBE LK, 12GPM

TABLE 3.2C-1 (Continued)

	<u>Date</u>	<u>S/D</u> <u>Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>	
3.2C-10	77 228	MC	303.7	MSS	HTEXCH	TUBE LK, SG1B	
	77 328	MC	177.7	MSS	HTEXCH	TUBE LEAK SG1B	
	77 5 7	MC	382.0	MSS	HTEXCH	TUBE LK OTSG 1B	
	77 918	CO	399.4	MSS	HTEXCH	SG MAINTEN AFTER REFUELING	
	78 421	MC	765.4	MSS	HTEXCH	LK IN 1B OTSG	
	781010	CO	333.8	MSS	HTEXCH	SG MAINT EXTEND RFL OUTAGE	
	781227	PH	-0.0	MSS	HTEXCH	HOLD AT 95PC, EVAL OTSG LK INDIC	F
	7612 4	MC	344.9	MSS	HTEXCH	OTSG 2B, TUBE LK, 2.5GPM	
	77 717	CO	993.6	MSS	HTEXCH	OTSG MNT, MAGNETITE BUILDUP, CRD STATR FL	
	77 911	MC	196.2	MSS	INSTRU	LK AT OTSG VIB TST INSIRU SEAL, OTSG 2B	
	7710 7	MC	497.0	MSS	HTEXCH	S/D TO INVEST LK IN OTSG 2B, LK NOT FOUND	
	7711 3	MC	201.8	MSS	HTEXCH	SUS OTSG LK, RPR LK ON POWDEX SYS	
	78 1 9	CO	239.8	MSS	HTEXCH	TUBE LK IN 2B OTSG, RPLC STATOR, CR5, GRP2	
	77 214	MS	222.4	MSS	HTEXCH	TUBE LK. SG3B	
	77 610	MC	212.5	MSS	HTEXCH	TUBE LK 3B OTSG, 1 TUBE, CIRCUM CRK-90DEG	
	77 714	MC	292.3	MSS	HTEXCH	TUBE LK 3B OTSG, 0.4GPM, PROP OF HI CYCL FATIGUE	
SYSTEM IS NUCLEAR INSTRUMENTATION							
	78 427	PH	-0.0	NIS	CALIBR	HOLD AT 94PC-NI CALIB	
	78 427	PH	-0.0	NIS	CALIBR	HOLD AT 97PC-NI CALIB	
	78 811	AS	34.7	NIS	INSTRU	RX-FLX/FLO IMBAL-OP TOOK RCP2B2 OFF, NI CH C,DFO	
				<u>Operator</u>	<u>In process of investigating bad RCP seal indication operator did not sufficiently reduce power as indicated on safety N.I.</u>		
SYSTEM IS ON-SITE POWER SYSTEMS							
	781229	CO	.3	OPS	TESTXX	PT/0/A/610/15 - Norm to emerg pwr tst	
	77 4 7	AS	6.1	TGS	POWSUP	<u>(Momentary 300 msec) installed 1 to 3 sec time delay to trip turb., LOSS 125VDC TO TURB CNTRL, RCP TRP DUR XFER P/S</u>	

TABLE 3.2C-1 (Continued)

<u>Date</u>	<u>S/D Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>	
7710 4	CO	236.6	RCP	SEALXX	OUTABE EXTENDED TO CORRECT RCP SEAL LK	
761016	MC	10.0	RCP	MOTORX	LO OIL LVL ON RCP MOTOR	
78 811	PR	-0.0	RCP	INSTRU	CHK SEAL LK INSTRU ON RCP 1B	F
78 812	PH	-0.0	RCP	SEALXX	HOLD FOR SEAL LK EVAL, RCP 2B1, 2B2	F
78 812	MC	227.2	RCP	SEALXX	RPLAC SEALS-RCP 2B1, 2B2	F
781218	CO	78.5	RCP	SEALXX	RCP 2A2 SEAL MNT, CONT. OF RLF OUTAGE	F
781222	CO	98.9	RCP	VALVEX	RPLC RCP SEAL INJECT SUPPLY VLV HP-66	F
781114	MC	9.7	RCP	PUMPXX	CORRECT HI VIB ON RCP 3B1	
77 619	CO	178.6	RCP	PUMPXX	LO OIL LVL ON RCP	
78 114	PR	-0.0	RCP	PUMPXX	LW OL LVL ALRM UPR OL PMP 3B1 REACT CLNT PMP	
78 330	PR	-0.0	RCP	PUMPXX	PR-75PC, RMOV 3B1RCP FRM SERV, LO OIL LVL ALARM	
78 4 1	PR	-0.0	RCP	MOTORX	RCP OFF DUE TO MTR UPPER OIL POT LVL ALARM	
78 4 1	AS	8.4	RPS	PUMPXX	RX WHEN PUT RCP BA1 BACK ON	
				Control	<u>RPS pump monitor trip delay CKT drifted to 80 msec, recalibrated to 200 msec</u>	
78 5 2	PR	-0.0	RCP	MOTORX	3B1 RCP OFF DUE TO MTR VP OIL POT LO LVL ALARM	
78 5 6	MC	6.1	RCP	MOTORX	ADD OIL TO 3B1 RCP MTR	

SYSTEM IS REACTOR COOLANT SYSTEM

771220	MC	92.4	RCS	VALVEX	PACK LK, VLVS RC-2, RC-16	
78 615	MC	180.4	RCS	VALVEX	PZR SAMP VLV (RC16) PK LK, RPLAC VLV	
7712 1	MC	19.5	RCS	VALVEX	LK ON PZR WTR SPACE SAMPL VLV, 2RC-16	
78 4 6	MC	191.3	RCS	VALVEX	PACK LK-PZR SPRAY CNTRL OUTLET BLK VLV, 2RC-3	
78 414	CO	263.0	RCS	GASKET	LK FRM O-RING ON MID HTR BUNDL ON PZR	
78 824	AS	9.5	RCS	VALVEX	RX-10 RC PRES WHEN PUT SPRY VLV 2-RC-1 IN AUTO	
				Control	<u>CKT failed to accept "Auto" mode. Wide range R.C. press. recorder failed to alarm low press C/B malposition of torque motor linkage. Operator failed to notice not in "Auto" and still spraying down.</u>	
781231	MC	10.6	RCS	VALVEX	PZR SPRAY WARM LINE THROT VLV 2RC2 PACK LK	

TABLE 3.2C-1 (Continued)

Date	S/D Method	Duration	System	Component	Description
77 224	MS	36.4	RCS	CHEMIS	HI CLORIDE CONC IN RCS, TS REQ VIOLATION
78 722	PR	-0.0	LPM	UNKNWN	INVEST NOIS PICKED UP BY LPM
781118	AS	16.6	RPS	INSTRU	RX ON POWER TRANS, FLUX/FLO IMBAL F0 <u>@ 100% F.P., Power transient up ~ .7 and flow transmitter oscillation down</u>
SYSTEM IS REACTOR PROTECTION SYSTEM					
781214	AS	10.1	RRS	INSTRU	SHT IN TEMP AVE XMIT CAUS RX ON OVRTEMP F0 <u>Tave recorder shorted input to RRS, shift to manual RRS cause erroneous Tave. (-13°F) int. FWCS, which shut FWCV's, SG's dry and EFW actuation.</u>
781226	AS	2.5	RPS	INSTRU OPERATOR	PWR IMBAL RX WHIL CALIB RPS INSTRU F0 <u>Chan "A" flow inop. and placed in trip condition; during testing Chan "D" not reset prior to clearing bypass.</u>
76 910	PR	-0.0	RPS	CONTRL	<u>RUNBACK CAUSED BY SPUR TRIP IN ONE CHANNEL</u>
SYSTEM IS REACTOR REGULATING SYSTEM					
78 328	AS	7.7	RRS	INSTRU	RX-FLUX-FLOW IMB-NEUTRON ERR IN CNTRL AFT CALIF
75 8 9	AS	13.1	COR	NONEXX Fuel	FLUX IMBAL ON RESTART <u>Due to abnormal flux distribution from reload. As core aged, it returned to normal pattern</u>
76 531	AS	2.0	FWS	NONEXX Pump	RX DUE TO HI RCS PRES <u>FW pump not respond to transient during transfer from auxiliary to main steam system due to dirty EHC. RCS relief block valve was stuck shut during loss feed flow transient, which caused high RC press. trip.</u>

TABLE 3.2C-1 (Continued)

<u>Date</u>	<u>S/D Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>
76 714	AS	4.1	RRS	NONEXX Operator	RX DUR ICS MNT <u>While trouble shooting RCP seal flow instr. prob. Tech. plugged in Hi volt P.S. and overloaded input breaker to electronics.</u> <u>Loss feed flow and Rx trip Hi par. press.</u>
78 6 5	PR	-0.0	RRS	INSTRU	CNTRL PROB CAUS REACT LIM ON B LOOP TAVE, RUNBCK
751014	AS	28.1	RRS	NONEXX Operator	RX-FLUX IMBAL <u>C/B operation too close to trip setpoints ~6.6%; power spike caused by rod stepping coincident with deboration @ steady state.</u>
76 420	AS	6.1	RRS	NONEXX Operator	TRIP ON FLUX IMBALANCE <u>Operating too close to trip setpoints, (within error margin to trip)</u>
77 414	AS	6.1	RRS	NONEXX Instr	SPUR POWER/FLOW TRIP <u>Operating too close to trip setpoints; Loose T_H RTD leads cause spurious low T_{Hot}, caused RRS to pull rods above 100% limit.</u> <u>Also internal limit on max. control signal limit drifted above 100% and was recalibrated.</u>

SYSTEM IS REACTOR VESSEL INTERNALS

76 418	MC	1033.7	RVI	INTERN	INSPECTION AND REPAIR OF RVI
76 4 7	MC	918.9	RVI	INTERN	INSPEC AND RPR RV SPECIMEN HOLDER TUBES
76 320	MC	677.7	RVI	INTERN	INSPEC, RPAIR RV SPECIMEN HOLDER TUBES

SYSTEM IS TURBINE GENERATOR SYSTEM

761118	MC	436.2	TGS	BEARNG	HI VIB CONDIT, TURB BRG
77 330	CO	102.4	TGS	BEARNG	TURB TURN GEAR OIL PUMP BRG FL
77 424	AS	11.2	TGS	VALVEX	RHTR HI LVL TRP, DRN VLV FLD TO OPEN <u>Fischer diaphragm linkage problem (dawg. CV1768)</u>
7712 9	MC	13.1	TGS	ELEFUN	GND PROB, GEN DIOD CAB, C/B DUST

TABLE 3.2C-1 (Continued)

<u>Date</u>	<u>S/D Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>
78 6 1	AS	6.1	TGS	VALVEX	EMER DMP VLV (HD28), B MSR FLD, HI MSR LVL TT-RX <u>Htr. drain valve stroke adjusted and LVL transmitter pilot relay was replaced</u>
78 8 2	AS	12.9	TGS	INSTRU Unknown	TRP MECH MALFUNC DUR PT/290-05 <u>Unexplain loss of EHC 125 VDC power for 5.4 sec. during testing.</u>
78 8 5	MC	18.6	TGS	PIPEXX	CRK-TURB XTRACT LINE TO B HP HTRS F
781030	NS	6.2	TGS	VALVEX	SPUR CLOS OF TURB INTERCEPT VLV AT power F
				RELAY	<u>Believed C/B stick mercury wetted relay contact</u>
781229	PR	-0.0	TGS	PIPEXX	WFLD LK ON HTR RELIEF VLV HD-331 F
77 9 4	MC	6.0	TGS	VALVEX	TURB MAIN STOP VLV MODIF
77 923	CO	7.6	TGS	PIPEXX	RPR LKING PIPE FITTING ON EHC
7712 7	NS	12.8	TGS	SOLENO	TURB TRIP SOLENOID PROB
781228	CO	21.6	TGS	TURBIN	GLAND STM XHAUSTR ALLWD WTR IN TURB OIL TNK F
77 315	NS	5.1	TGS	PIPEXX	TURB OFF-LINE, RPR EXTRACT LINE LK
771013	AS	9.7	TGS	CONTRL	INDIC LOSS 125 DC TO EHC CAUS TRIP <u>Added 1 to 3 sec time delay to actuation of loss of EHC dc pwr trip</u>
78 1 4	PR	-0.0	TGS	HTEXCH	MOIST-SEP RHTR DRNS TO CDS
78 4 1	NS	2.3	TGS	TESTXX	TURBIN TRIP TST
78 729	NS	4.0	TGS	TESTXX	TURB TRIP TST
78 8 8	AS	2.7	TGS	CKTBRK	MCC-3XA TRPPD, LOP TO EHC SYS PUMPS F <u>Both EHC pumps on same bus which was tripped due to failure of CKT breaker to isolate faulted welding machine. Site plans to separate pwr. supply</u>
78 929	PR	-0.0	TGS	VALVEX	DUR TURB VLV TST, TSV4 NOT REOPEN IMED, DELAY F
7811 3	MC	9.9	TGS	SOLNOD	RPLC BAD SOLENOID ON MSSV 4 ON TURB F
781218	MC	4.6	TGS	CONTRL	TEMPORARY PWR FL TO EHC SYS F

TABLE 3.2C-2
SYSTEM RANKING SUMMATION

<u>Major Plant System/Component</u>	<u>RANKING OF OCCURRENCES</u>		
	<u>Impacting Plant Safety</u>	<u>Impacting Plant Availability</u>	<u>DAS Application</u>
Auxiliary Feedwater System	4	8	8
Area Radiation Monitoring			
Boric Acid Injection System			
Chemical and Volume Control System		4	5
Compressed Air System	2	7	
Component Cooling Water System			
Condensor System			
Containment Isolation System			
Containment System			
Communications System			
Reactor Core/Fuel/Vessel			
Control Rod System		2	
Circulating and Saltwater System			
cooling Tower System			
Demineralized Water System			
Emergency Diesel Generators			
Electrical Distribution System (Grid)			
Emergency Core Cooling System	5		7
Main Feedwater System	1	1	2
Main Steam System			
Process Instrumentation	7	5	4
Nuclear Instrumentation			
Natural Phenom/External Causes			
On-Site Power System			
Personnel	8	6	
Plant Computer			
Reactor Coolant Pumps			6

TABLE 3.2C-2 (Continued)

<u>Major Plant System/Component</u>	<u>RANKING OF OCCURRENCES</u>		
	<u>Impacting Plant Safety</u>	<u>Impacting Plant Availability</u>	<u>DAS Application</u>
Reactor Coolent System	3		1
Reactor Protection System	6	3	
Reactor Regulating System			
CEA Position Indicating System			
Sampling System			
Shutdown Cooling System			
Turbine Generator System			
Waste Management System			

The top 8 systems ranked by system (1 thru 8) in decreasing order of importance for each of the three columns, based on survey of 7 site operating personnel.

APPENDIX 3.2-D

SITE VISIT REPORT #3

3.2-D-i/3.2-D-ii

APPENDIX 3.2D
TRIP REPORT #3
PWR COMPONENT FAILURE STUDY
VERIFICATION OF PWR SHUTDOWN DATA BASE
EVENTS BY A SITE VISIT

PURPOSE

During the period of the study a trip was made to a dual unit site to verify entries in the C-E shutdown data base. More specifically, the purpose of the trip was to identify the root causes of the power plant outages resulting from failures in electrical equipment.

The shutdown data base for these two plants (Table 3.2D-4) shows 63 trips and power reductions during 1977 and 1978. Of this number, 26 resulted from anomalies in electrical equipment and were verifiable in trip status reports. A summary of the root causes of these anomalies is presented in Tables 3.2D-1 and 2.

A review of Tables 1 and 2 provides the following breakdown of root causes.

1. Failures that result in manual control of steam generator water level.

a. Failure of solenoid valve (1 event)	3.0 hours
b. Breaker opening (3 events)	11.2 hours
c. I/P converter (1 event)	.7 hours
d. Failure of FWCS (1 event)	1.4 hours
e. Level oscillations (2 events)	<u>11.1</u> hours
	27.4 hours

2. Failures in circuit breakers.

a. Underfrequency relays (3 events)	6.5 hours
b. Spurious generator breaker opening (1 event)	7.6 hours
c. Failures in test relay (3 events)	<u>15.3</u> hours
	29.4 hours

3. Failures in alarm and monitoring system.

a. RCP oil tank level alarm (2 events)	23.0 hours
--	------------

4. Failure of turbine generator voltage regulator circuits resulted in 3.7 outage hours (2 events).

5. Failures resulting in rod drops.

a. MG set induced problems (2 events)	4.3 hours
---------------------------------------	-----------

b. Unknown (1 event)	<u>5.9</u> hours
----------------------	------------------

13.9 hours

6. Maintenance induced problems.

a. Transmitter maintenance (1 event)	1.4 hours
--------------------------------------	-----------

b. Panel not properly identified (1 event)	<u>5.3</u> hours
--	------------------

6.7 hours

7. Miscellaneous induced problems.

a. Solenoid valve failure resulting in closure of MSIV (1 event)	4.2 hours
--	-----------

b. I/P converter failure resulting in improper positioning of pressurizer spray valve (1 event)	<u>8.9</u> hours
---	------------------

13.1 hours

In conclusion, several general comments are considered to be worthy of mention.

1. Data base entries are based upon the initial reasoning that supported the decision to shut the plant down for corrective action. This reasoning is not always supported by the root cause. For example, on February 5, 1977 Unit #3 was shut down to investigate and correct the

cause of an apparent oil leak on Reactor Coolant Pump 3A. Subsequent investigation revealed that the alarm setpoint was improperly giving an indication that a leak existed. In order for the data base to be a more useful tool it should be periodically updated to show the actual cause of the problem.

2. During the site visit plant operating and maintenance personnel were asked to identify the twelve systems that were the most troublesome from the standpoint of maintenance and operation. The results of this survey are shown in Table 3.2D-3.
3. Single failures in certain systems will cause the unanticipated loss of plant availability. Because these failures are unanticipated, replacement power is more expensive vis-a-vis the cost for planned replacement power. Additionally, plant trips result in a major perturbation to the total power plant and have the capability for aggravated results with other equipment failures.

For these major reasons, plant safety, as well as availability, must be a part of the total design process. In other words, equipment and systems must be designed for performance, which means that it must be designed so that it will perform its intended purpose, and such that it will not fail in a normal operational period.

Additionally, the requirements for scheduled maintenance must also be integrated into the design process. The maintenance program must be such that it is possible to keep the system in a condition consistent with built-in levels of performance, reliability, and safety without an undue expenditure of effort and to restore system operation in a timely fashion in the event of system in-service failures or misoperation. Tables 3.2D-1 and 2 show that certain single failures can occur to turbine generator systems, main steam and feedwater systems, rod control systems, circuit breakers in general, reactor coolant pumps, as well as automatic control systems (especially the ability for operators to effectively use these systems to manually control process conditions) and that these failures can result in an unanticipated loss of plant availability.

TABLE 3.2D-1

YEAR 1977

<u>ROOT CAUSE OF ANOMALY</u>	<u>UNIT</u>	<u>SYSTEM</u>	<u>OUTAGE DURATION</u>	<u>TYPE OF TRIP</u>
1. Failure of Solenoid Valve (7/12/77)	3	Main Feedwater System	3.0	Automatic Scram
2. Plant Tripped When Restoring Transmitter to Service (1/24/77)	3	Non-Nuclear Proc. Inst.	1.4	Automatic Scram
3. Solenoid Valve Failure Caused MSIV to Close (8/5/77)	4	Main Steam System	4.2	Automatic Scram
4. Spurious Brk Opening to SG LVL System (8/6/77)	4	On-Site Power System	2.3	Automatic Scram
5. Spurious Brk Opening to SG LVL System (8/7/77)	4	On-Site Power System	4.7	Automatic Scram
6. Spurious Brk Opening to SG LVL System (12/9/77)	4	On-Site Power System	4.2	Automatic Scram
7. RCP 3A Oil Tk Level Alarm Spurious (2/5/77)	3	Reactor Coolant Pumps	12.3	Manual Controlled
8. Gen Breaker Spurious Opening (7/23/77)	3	Turbine Gen. System	7.6	Manual Scram
9. Gen Voltage Reg Failure (1/19/77)	3	Turbine Gen. System	1.2	Automatic Scram
10. Gen Voltage Reg Failure (8/3/77)	4	Turbine Gen. System	2.5	Automatic Scram

TABLE 3.2D-1 (Continued)

	<u>ROOT CAUSE OF ANOMALY</u>	<u>UNIT</u>	<u>SYSTEM</u>	<u>OUTAGE DURATION</u>	<u>TYPE OF TRIP</u>
	11. Panels Not Properly Identified (1/21/77)	3	Operator or Tech. Error	5.3	Automatic Scram
	12. MG Vibration Caused Brk to Open (2/21/77)	3	Rod Control System	2.7	Automatic Scram
	13. Suspect M/G Problems (9/9/77)	4	Rod Control System	1.6	Automatic Scram
	14. Test Relay for Monitoring Circuit Breaker Position Failed (5/16/77)	3	Reactor Protection System	11.2	Automatic Scram
3.2D-5	15. Test Relay for Monitoring Circuit Breaker Position Failed (7/23/77)	3	Reactor Protection System	1.7	Automatic Scram
	16. Test Relay for Monitoring Circuit Breaker Position Failed (9/28/77)	3	Reactor Protection System	2.4	Automatic Scram

TABLE 3.2D-1

YEAR 1978

	<u>ROOT CAUSE OF ANOMALY</u>	<u>UNIT</u>	<u>SYSTEM</u>	<u>OUTAGE DURATION</u>	<u>TYPE OF TRIP</u>
	17. Steam Gen Level Oscillations (11/27/78)	3	Main Feedwater	1.6	Automatic Scram
	18. Steam Gen Level Oscillations (Blowdown transmitters)(12/7/78)	3	Main Feedwater	9.5	Automatic Scram
	19. Failure of I/P Converter FW Reg Valve (Packing leak into converter) (7/7/78)	4	Main Feedwater	.7	Automatic Scram
3.2D-6	20. Failure of Automatic FWCS (12/11/78)	4	Main Feedwater	1.4	Automatic Scram
	21. RCP 4A Oil Tk Level Alarm Spurious (12/13/78)	4	Reactor Coolant Pumps	10.7	Automatic Scram
	22. Failure of Pressurizer Spray Valve I/P Converter (converter failed due to high temperature)(10/6/78)	4	Reactor Coolant System	8.9	Automatic Scram
	23. Rod Drop-Cause Unknown (4/19/78)	3	Rod Control System	5.9	Manual Scram
	24. Underfrequency Relay Failed (3A2) (11/27/78)	3	Reactor Protective System	1.7	Automatic Scram
	25. Underfrequency Relay Failed (3A2) (11/28/78)	3	Reactor Protective System	2.6	Automatic Scram
	26. Underfrequency Relay Failed (3B2) (12/6/78)	3	Reactor Protective System	2.2	Automatic Scram

TABLE 3.2D-2
SYSTEM RANKING SUMMATION

<u>Major Plant System/Component</u>	<u>RANKING OF OCCURRENCES</u>		
	<u>Impacting Plant Safety</u>	<u>Impacting Plant Availability</u>	<u>DAS Application</u>
Auxiliary Feedwater System	1	7	
Area Radiation Monitoring			
Boric Acid Injection System	3	6	
Chemical and Volume Control System	6	5	
Compressed Air System	5		
Component Cooling Water System			
Condensor System		4	
Containment Isolation System			
Containment System			DATA
Communications System			NOT
Reactor Core/Fuel/Vessel			TAKEN
Control Rod System	9	9	
Circulating and Saltwater System		8	
Cooling Tower System			
Demineralized Water System			
Emergency Diesel Generators	2		
Electrical Distribution System (Grid)	11		
Emergency Core Cooling System	10		
Main Feedwater System	4	2	
Main Steam System		3	
Process Instrumentation			
Nuclear Instrumentation	7	12	
Natural Phenom/External Causes			
On-Site Power System			
Personnel			
Plant Computer			
Reactor Coolant Pumps	8	1	

TABLE 3.2D-2 (Continued)

<u>Major Plant System/Component</u>	<u>RANKING OF OCCURRENCES</u>		
	<u>Impacting Plant Safety</u>	<u>Impacting Plant Availability</u>	<u>DAS Application</u>
Reactor Coolent System		10	
Reactor Protection System			
Reactor Regulating System			
CEA Position Indicating System			
Sampling System			
Shutdown Cooling System			
Turbine Generator System	12	11	
Waste Management System			

Pick the top 12 systems and rank the estimated occurrences (1 thru 12) in decreasing order of importance for each of the three columns.

TABLE 3.2D-3

SITE 3 PWR SHUTDOWN DATA BASE

<u>Date</u>	<u>S/D Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>	
SYSTEM IS MAIN FEEDWATER SYSTEM						
77 6 1	PR	-0.0	FWS	VALVES	RPR FWP DICHARG CHK VLV SEAL RING LK	
78 513	NS	3.0	FWS	VALVEX	RPR FW CHK VLV PACK LEAK	
78 7 6	NS	19.4	FWS	VALVEX	RPR LKING VLV BODY-RPLAC VLV	
781015	CO	25.5	FWS	HTEXCH	FW HTR 4B, TUBE LKS	S
781127	AS	1.6	FWS	CONTRL	SG LVL RX, FW TRANS DUR LOAD INC	F
7812 7	AS	9.5	FWS	VALVOP	RX-SG LVL, FW REG VLV CLOSD SUDDENLY	F
761019	AS	1.1	FWS	VALVOP	FW REG CLOSED, FL OF SOLENOID VALVE	
771111	AS	2.0	FWS	VALVOP	LL RX, SU, FW ISOL VLV NOT OPEN, AUTO-MAN DISENG	
771217	AS	3.0	FWS	CONTRL	LL RX, TRANS WHILE INCREAS LOAD	
78 7 7	AS	.7	FWS	CONTRL	ELEC CMP FL, FWS CNTRL, REG VLV OPEN, HI LVL RX	
781211	AS	1.4	FWS	CONTRL	FW TRANS DUR LOAD INC, RX ON SG LVL	F
SYSTEM IS NON-NUCLEAR PROCESS INSTRUMENTATION						
77 124	AS	1.4	INS	XMITTR	RCS FLO CH3 DIP WITH CH2 IN TST, XMIT FL	
SYSTEM IS MAIN STEAM SYSTEM						
78 519	NS	52.5	MSS	UNKNWN	RPR MISC SEC SYS STM LKS	
78 730	MC	204.8	MSS	HTEXCH	SG-3C TUBE LK	
7610 9	MC	115.7	MSS	HTEXCH	TUBE LK IN SG4B	
77 1 6	MC	129.7	MSS	HTEXCH	SG 4C TUBE LK	
77 125	MC	113.4	MSS	HTEXCH	SG 4C TUBE LK	
77 320	MC	152.7	MSS	HTEXCH	SG 4C TUBE LK, PLUG LKING TUBE, ONE OTHER	
77 426	MC	182.3	MSS	HTEXCH	SG 4C, 3 LKING TUBES	
77 8 5	AS	4.2	MSS	VALVOP	MSIV CLOSD, INTRMIT OPEN-VLV CNTRL SYS	
771028	MC	327.5	MSS	HTEXCH	TUBE LK SG4B, PLUG 1 TUBE	

3.2D-9

TABLE 3.2D-4 (Continued)

<u>Date</u>	<u>S/D Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>	
SYSTEM IS ON-SITE POWER SYSTEMS						
7612 4	AS	3.2	OPS	PWRSUP	LOSS VIT INS BUS P/S, SG HI LVL TRP DUR TRANS	
77 8 6	AS	2.3	OPS	PWRSUP	LOSS VIT INS P/S TO SG LVL PROTECT SYS	
77 8 7	AS	4.7	OPS	RELAYX	LOSS VIT INS P/S TO SG LVL PROTECT SYS	
7712 9	AS	4.2	OPS	BUSXXX	LOSS VIT BUX P/S, AFFECT SG LVL PROT SYS, LL RX	
SYSTEM IS REACTOR COOLANT PUMPS						
77 2 5	MC	12.3	RCP	PIPEXX	RCP 3A, OIL LK	
77 811	AS	89.8	RCP	PIPEXX	TTRS, TUBE RLAY BMPD, RCP SEAL INJCT LINE CONN	L
7812 2	MC	213.9	RCP	SEALXX	RPR RCP 4A SHFT SEAL SYS, INSTL NEW SEAL ASSY	S
781213	NS	10.7	RCP	TESTXX	CHK OIL LVL IN RCP 4A MTR	F
77 422	MC	9.8	RCS	VALVEX	RPR DRN VLV STEM PACK LK INSIDE CNTM	
7810 6	AS	8.9	RCS	INSTRU	PART OPEN PZR SPRY VLV CLOS DUR TS, RPS INIT	F
SYSTEM IS TURBINE GENERATOR SYSTEM						
77 119	AS	1.2	TGS	CONTRL	SUDDN DROP IN CNTRL OIL PRES, TURB TRP-RX.	
77 614	AS	7.0	TGS	CONTRL	TRANS PRES CONDIT IN AUTO STOP OIL SYS (EHC)	
77 718	MS	10.7	TGS	FILTER	FILTER GEN SEAL OIL LK, BAD SEAL OIL FILTER	
77 723	MS	7.6	TGS	CKTBKR	2ND OF 2 GEN BKR OPEND DUR SWITCH OPER	
77 929	MC	24.2	TGS	VAVLFX	RPLAC FLD DISC ASSY IN TURB STOP VLV	
771012	AS	1.2	TGS	REGULA	TRP C/B MALFUNCT OF GEN VOLT REG	
78 218	NS	3.7	TGS	GENERA	BAL GEN XCITR	
78 511	AS	10.2	TGS	PIPEXX	RPR MSR ALT DRN LINE TO COND	
78 6 2	MC	22.5	TGS	TURBIN	OUT TO BAL TURN, HRS EST. TOT TIME=45	
78 6 2	CO	22.5	TGS	VALVEX	RPR STM LK ON CHK VLV, HRS EST, TOT TIME=45	
78 7 7	AS	3.0	TGS	CONTRL	EHC MALFUNC DUR SU	
78 713	PR	-0.0	TGS	TESTXX	EXERCISE COMPS IN CNTRL SYS	

3.2D-10

TABLE 3.2D-4 (Continued)

<u>Date</u>	<u>S/D Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>	
781015	MC	6.9	TGS	TURBIN	BAL TURN	S
781021	NS	6.3	TGS	PIPEXX	RPR STM LK AT DRN CONNEC	F
761019	AS	1.7	TGS	REGULA	RX-MALFUNC VOLT REGULAT, ATC. LOSS FIELD RELAY	
761019	AS	2.3	TGS	REGULA	RX-MALFUNC VOLT REGULAT, ACT. OVEREXCITE RELAY	
77 8 3	AS	2.5	TGS	CONTRL	SG HI LVL DUR TRANS C/B TURB CNTRL MALFUNC, TTR	
77 8 4	NS	1.7	TGS	INSULA	UNIT FRM SERV, XTING FIRE-INSULAT NR TURB GLAN	
77 822	NS	12.4	TGS	WELDXX	WLD LK, TURB CNTRL SERV MTR OIL SUPPLY LINE, MAN	
77 9 1	NS	25.0	TGS	HTEXCH	RPR MOIST SEP RHTR TUBE LKS	
77 922	AS	2.6	TGS	REGULA	LOS GEN FIELD RLAY ACTUAT, RPR GEN VOLT REG	
78 428	PR	-0.0	TGS	TESTXX	TEST TURB MS STOP, REHEAT STOP AND INTERCPT VLV	
78 730	AS	6.0	TGS	PIPEXX	RPR LK ON DRN LINE FOR MW STM LINE TO MSR	
7810 1	AS	3.8	TGS	INSTRU	TURB PROTECT SYS TRP UNIT DUR TST	F
7810 2	MC	11.4	TGS	TESTXX	TURB OVRSPD TST, T EST FRM TOT OUTAGE	S
781015	AS	1.0	TGS	MECFUN	TURB TRP RELATCH NOT RESET AFT SURV TST	F

SYSTEM IS OPERATOR OR TECHNICIAN ERROR

7610 7	MS	.9	OPR	CKTBKR	OPEND RCP BREAKER IN ERROR	
721220	AS	.4	OPR	NONEXX	POWER ABOVE P-7 TRP LVL WITH TURB TRIPPED	
73 115	AS	5.9	OPR	NONEXX	INADVERT ISOL OF RUNNING FWP	
73 121	AS	.5	OPR	NONEXX	P-7 PERMISSIVE UNBLOCKED WITH TURB TRIPPED	
73 122	AS	2.2	OPR	NONEXX	P-7 PERMISSIVE UNBLOCKED WITH TURB TRIPPED	
73 228	MC	.1	OPR	NONEXX	STOPPED STARTUP-ECC WRONG-RECALC	
73 3 2	AS	.6	OPR	NONEXX	LOS PWR TO 3P07, ELECTRICIAN ERROR	
73 7 9	AS	1.8	OPR	NONEXX	TRP BRK B OPEN, TB-A BYPASS DUR LOGIC TST	
73 7 9	AS	9.9	OPR	NONEXX	P-7 PERMISS UNBLOCK WITH TURB TRPPD DUS TST	
73 819	AS	.6	OPR	NONEXX	ELECT GND RAD MON PANEL, VOLT DECREAS-VIT BUS	
73 824	AS	.6	OPR	NONEXX	SPUR LO FLO TRP, TECH VENTD FLO XMIT WRONG	
731117	AS	.9	OPR	NONEXX	OP ERR DUR TURB VAC TRIP	
74 2 6	AS	11.0	OPR	NONEXX	MAINT T/S CAUSE LOSS VIT BUS	
74 617	MS	2.0	OPR	NONEXX	OPER MAN OPENED REACT TRIP BREAKR	

TABLE 3.2D-4 (Continued)

<u>Date</u>	<u>S/D Method</u>	<u>Duration</u>	<u>System</u>	<u>Component</u>	<u>Description</u>	
74 730	AS	8.9	OPR	NONEXX	LOS POWER TO CRDM GRP DUE TO TROUBL SHOOT ERR	
75 3 2	AS	.3	OPR	NONEXX	PZR LO-LO LVL, OPER INC PWR TOO FAST, DEPRS T-AVE	
76 422	AS	1.1	OPR	NONEXX	OPR RMOVE UNDERVOLT TIME DELAY RELAY IN ERROR	
76 628	AS	1.3	OPR	NONEXX	PWR RANGE CH RMOV FRM SERV, OTHR CH IN TST	
77 121	AS	5.3	OPR	NONEXX	DUR TST, OP PUT 2ND CH IN TST IN ERROR	
75 7 5	AS	1.8	OPR	VALVEX	INADVERT CLOSED MSIVS	
74 719	AS	2.0	OPR	NONEXX	WORKR ACT TURB TRIP DEVICE	
74 910	AS	.8	OPR	NONEXX	LO COND VAC TRIP, OP OPENED TURB VLVS TOO FAST	
7411 7	AS	6.2	OPR	NONEXX	OP ERROR-LOSS PWR TO 1 VITAL INSTRU BUS, HI SG L	
75 9 3	AS	.6	OPR	NONEXX	SIAS, HI STM FLO/LO T-AVE, OP DMP STM TO OPH MSIV	
76 1 6	AS	1.6	OPR	NONEXX	LO SG LVL, TEST SIG IN FW CNTRL SYS IN ERROR	
SYSTEM IS REACTOR PROTECTION SYSTEM						
75 3 2	AS	3.3	RPS	BISTAB	BISTABLE FL WHEN OTHER IN TRIP FOR TST	
7812 6	AS	8.5	RPS	INSTRU	RX ON BRRON STM FLO SIG	FO
7510 2	AS	3.7	RPS	RELAYX	RCP BRKR POSIT RELAY FL, SPUR BRKR OPEN SIGNAL	
76 6 9	AS	1.3	RPS	RELAYX	MOMENT ACTUAT OF RELAY IN RPS, CLN CONTACTS	
77 516	AS	11.2	RPS	RELAYX	RX C/B SPUR ACT OF RELAY IN RPS	
77 723	AS	1.7	RPS	RELAYX	SPUR OP OF RELAY IN RPS	
77 928	AS	2.4	RPS	RELAYX	RX C/B SPUR OP OF RELAY IN RPS, RPLAC RLAY COIL	
781127	AS	1.7	RPS	RELAYX	SPUR ACTUAT OF UNDFREQ RLAY 3A2	FO
781128	AS	2.6	RPS	RELAYX	SPUR ACTUAT UNDFREQ RLAY 3A2-RPLC RELAY	FO
7812 6	AS	2.2	RPS	RELAYX	SPUR ACTUAT UNDFREQ RLAY 3B2	FO
SYSTEM IS CONTROL ROD SYSTEM, RODS, DRIVES, CONTROLS						
77 221	AS	2.7	CRS	PWRSUP	LOSS SECOND OF TWO CRS POWER SUPPLIES	
78 419	MS	5.9	CRS	CRDRVE	3 CONROD OUT OF ALIGN DUR REACT PHYSICS TSTS	
77 9 9	AS	1.6	CRS	PWRSUP	LO VOLT CONDIT ON ROD CNTRL SYS P/S CAUSE RX	

3.2D-12

TABLE 3.2D-4 (Continued)

SYSTEM CODES

ADM	Administrative shutdown or power limit
AFS	Auxiliary feedwater system
BAC	Area monitoring system-radiation protect
BAS	Boric acid injection system - west.
BDS	Blowdown system
CAS	Compressed air system
CCW	Component cooling water system
CDS	Condenser system
CIS	Containment isolation system
COM	Communication system
COR	Reactor core - fuel
CRS	Control rod system, rods, drives, controls
CSW	Circulating and salt water systems
CTM	Containment System
CTS	Cooling tower system
CVC	Chemical and volume control system
DMS	Demineralized water system
EDG	Emergency diesel generators
EDS	Electrical distribution system
EOC	End of cycle - coastdown
ESF	Engineered safety features - ECCS
FWS	Main feedwater system
HDS	Hold down system - seismic restraints
INS	Non-nuclear process instrumentation
LPM	Loose parts monitoring system
MNT	Maintenance
MSS	Main steam system
NAT	Natural phenomenon
NIS	Nuclear instrumentation
OPR	Operator or technician error
OPS	On-site power systems
PPC	Plant process computer
RCP	Reactor coolant pumps
RCS	Reactor coolant system
REG	Regulatory requirement or restriction
RFL	Refueling
RPI	Rod position indicating system
RPS	Reactor protection system
RRS	Reactor regulating system
RVI	Reactor vessel internals
RVS	Reactor vessel
SAM	Sampling system
SBD	Containment ventilation system
SCW	Secondary component cooling water system
SCX	Containment air purification and cleanup

TABLE 3.2D-4 (Continued)

SYSTEM CODES

SDC	Shutdown cooling system
TBS	Turbine bypass system
TGS	Turbine generator system
TST	Testing and/or training
UNK	Cause unknown or not specified
WMS	Waste management system
XTN	External causes

APPENDIX 4-A

THE COST-BENEFIT MODEL

4-A-i/4-A-ii

A. THE COST BENEFIT MODEL NET BENEFIT CALCULATION

In order to properly evaluate the many different proposed solutions to availability problems, a method was developed to quantify the economics of each problem-solution pair. The value of an engineering solution is measured by its net benefit. The net benefit is the present worth cost difference over the plant lifetime due to the implementation of an engineering solution to an availability problem. A positive net benefit indicates a solution will save the plant money. A solution with negative net benefit will cost more to pay for itself than the increased availability is worth. The value of a net benefit can be found using the formula:

$$\text{NET BENEFIT} = \text{BG} - \text{TAC}$$

where:

BG = the benefit gained due to increased availability over the remaining plant life

TAC = the total annualized cost of paying for the solution

B. CALCULATION OF BENEFIT GAINED

The benefit gained is the sum of each years savings over the remaining plant lifetime. A present worth factor (a function of the time from the implementation time to the year of the savings) multiplied by the sum of the different benefit contributions, (replacement power, capital cost, direct repair costs). Each years benefit is then added to the previous years sum to equal the benefit gained. In equation form this translates to:

$$\text{BG} = \sum_{n=1}^{n=\text{RPL}} (\text{PWF}) \times (\text{B1} + \text{B2} + \text{B3} + \text{B4})$$

where

BG = Benefit gained

PWF = the present worth factor

RPL = remaining plant life

- B1 = replacement power costs during the 1st 6 hours of shutdown
- B2 = replacement power costs during the remainder of the shutdown
- B3 = direct outage repair costs
- B4 = avoided future capital costs

An exact form of the equation is given in figure 4-A.1.

C. TOTAL ANNUALIZED COST CALCULATION

The total annualized cost due to the implementation of a proposed engineering solution is calculated as follows. The engineering, hardware and installation costs are summed. This sum is then multiplied by the levelized annual fixed charge rate. Added to this sum is the annual maintenance costs. This sum is then divided by the plant capacity to provide the total annualized cost in dollars per kilowatt (\$/KW). The one time engineering cost is divided by the number of plants implementing the solution to distribute this large cost among all the plants to which it is applicable. The equation used in the CENBAC model is shown in figure 4-A.2.

Since cost estimates are not precise, a probabilistic method was used to calculate the range of net benefits. A net benefit probability density curve is used to display the distribution of the net benefit. A similar technique is described in reference 7. A computer program is used to evaluate the effects of the probability distributions of the input variables on the resultant (net benefit). The program used to convolute these input distributions is called SIGMA1, and has been used for several years to deal with uncertainties in data. The output of SIGMA1 is the net benefit probability density curve. It shows the probability over the range of net benefit values. A table is also produced which provides precise values for the limits of the intervals as well as the probability of finding the net

benefit above, within, or below each interval. SIGMA1 has been modified to provide input to CEGGS, a generalized graphics program that will display refined curves on a drum type plotter. Appendix 4-C contains further information on SIGMA1.

A listing of the CENBAC code is included on the following pages.

```

10          CENRAC LISTING
20 ATTACH(IMSL,IMSL,ID=USER)
30 LIBRARY(IMSL)
40 ATTACH(X,MS11099484SIGMARK1G079xxx,ID=STR0LL0)
50 FTH.
60 REWIND(LG0)
70 LDSET(PRESET=ZERO)
80 LOAD(X)
90 LOAD(LG0)
10 EXECUTE.
10 DISPOSE(TAPER,*PR)
20 EXIT(S)
30 /EOR
40      SUBROUTINE QUATTID(X1,X2,X3,X4,X5,X6,X7,X8,REM)
50      COMMON GMR1 ,GMR2 ,GMR3 ,GMR4 ,GMR5 ,GMR6
60      COMMON HR1 ,HR2 ,HR3 ,HR4 ,HR5 ,HR6
70      COMMON Y1 ,DT ,CRP ,A01 ,LAFC ,XPC
80      COMMON IRPL ,PVER ,MG ,PC ,VC1 ,VC2
90      COMMON /ENCDA1/ A1,A2,A3,A4,A5,VC3,A7
10     COMMON /ENCDA1/ C1,C2,C3,C4,C5,VC4,C7
10     COMMON DTEC ,DPIS ,PPFC ,PPHC ,PPIC ,ALFC
20     COMMON AMC ,IAC
30     REAL IRPL, LAFC
40     FC1(Y) = A1 * ( 1.0 + C1 ) ** Y
50     FC2(Y) = A2 * ( 1.0 + C2 ) ** Y
60     FC3(Y) = A3 * ( 1.0 + C3 ) ** Y
70     FC4(Y) = A4 * ( 1.0 + C4 ) ** Y
80     FC5(Y) = A5 * ( 1.0 + C5 ) ** Y
90     CNP(Y) = A7 * ( 1.0 + C7 ) ** Y
10     DATA A1 / 3.59/
10     DATA A2 / 2.71/
20     DATA A3 / 1.23 /
30     DATA A4 / 1.79 /
40     DATA A5 / 0.53/
50     DATA A7 / 1092./
60     C1 = X1
70     C2 = X1
80     C3 = X2
90     C4 = X3
10     C5 = X4
10     C7 = X5
20     GMR1 = 0.065
30     GMR2 = 0.166
40     GMR3 = 0.404
50     GMR4 = 0.104
60     GMR5 = 0.108
70     GMR6 = 0.006
80     VC1 = 0.00205
90     VC2 = 0.00030
100    VC3 = 0.00416
110    VC4 = 0.00072

```



```

520      HR1 = 12000.0E-06
530      HR2 = 9200.0E-06
540      HR3 = 10200.0E-06
550      HR4 = 11000.0E-06
560      HR5 = 10400.0E-06
570      HR6 = 15000.0E-06
580      DI = 8.20
590      YI = 0.51
600      CRP = 00.0
610      AOL = 40.0
620      PC = 1.E+06
630      IRPL = 40.0
640      PVIR = 0.038
650      LAFC = 0.18
660      G1 = GMR1 * HR1
670      G2 = GMR2 * HR2
680      G3 = GMR3 * HR3
690      G4 = GMR4 * HR4
700      G5 = GMR5 * HR5
710      G6 = GMR6 * HR6
720      B1N1 = VC1*(GMR1+GMR6)
730      B2N1 = VC3*GMR3+VC2*(GMR2+GMR4)+B1N1
740      RG = 0.0
750      UN = 1.0
760      NRPL = IRPL
770      DO 1000 I = 1, NRPL
780      UN = UN / ( 1.0 + PVIR )
790      I = 1
800      B1N = G1*FC1(I)+G6*FC4(I)+B1N1
810      B1D = (GMR6+GMR1)
820      B1 = YI*(B1N/B1D-HR5*FC5(I))+6.
830      B2N = G1*FC1(I)+G2*FC2(I)+G3*FC3(I)+G4*FC4(I)+G6*FC4(I)+B2N1
840      B2D = GMR6+GMR1+GMR2+GMR3+GMR4
850      B2 = YI*(DI-6.)*(-HR5*FC5(I)+(B2N/B2D))
860      B3 = YI*( CRP + DI*AOL ) / PC
870      B4 = YI*DI*LAFC*CRP(I) / 8760.0
880      RG = RG + UN*( B1 + B2 + B3 + B4 )
890 1000 CONTINUE
900      NIEC=0.0
910      NPIS=1.0
920      PPEC=26
930      PPHC=0.0
940      PPIC=1000.0
950      ALFC=0.18
960      AMC=1000.0
970      TAC=((NIEC/NPIS)+PPEC+PPHC+PPIC)*ALFC+AMC)/PC
980 C      CALCULATION OF RESULTANT VARIABLE AS BASED ON INPUT FUNCTIONAL
990 C      RELATIONSHIP OF INDEPENDENT VARIABLES TO RESULTANT.
1000 C      REM=FUNCT[UN](X1,X2,X3,X4,X5,X6,X7,X8)
1010      REM=RG - TAC
1020      RETURN
1030      END

```

```

1040 C          CENRAC SAMPLE DATA
1050 C          LOSS OF MAIN FEEDWATER PUMP
1060 C          CAUSE-      LOW PUMP SUCTION PRESSURE
1070 C          POSSIBLE SOLUTION-  CHANGE SITE PROCEDURE
1080 C          DATA-      D1=8.2 HOURS      Y1=0.61      PPEC=$6400.0 (160 MHR$)
1090 /EOR
1100          6
1110          20          20          20          20          20          20
1120          3          0.05000          0.05
1130          0.07          0.11          0.14          0.12          0.11
1140          0.09          0.08          0.07          0.06          0.05
1150          0.04          0.03          0.02          0.01          0.00
1160          0.00          0.00          0.00          0.00          0.00
1170          3          0.01500          0.0150000
1180          0.02          0.04          0.06          0.09          0.12
1190          0.10          0.02          0.08          0.07          0.06
1200          0.05          0.04          0.04          0.03          0.03
1210          0.02          0.02          0.02          0.01          0.01
1220          3          0.015          0.015
1230          0.01          0.01          0.01          0.02          0.02
1240          0.03          0.03          0.04          0.04          0.04
1250          0.05          0.06          0.07          0.08          0.09
1260          0.10          0.12          0.10          0.05          0.03
1270          3          0.00260          0.002000
1280          0.01          0.01          0.02          0.03          0.04
1290          0.05          0.06          0.08          0.10          0.10
1300          0.10          0.10          0.08          0.06          0.05
1310          0.04          0.03          0.02          0.01          0.01
1320          3          0.0725          0.0725
1330          0.02          0.05          0.09          0.105          0.10
1340          0.10          0.09          0.08          0.07          0.06
1350          0.05          0.05          0.04          0.03          0.02
1360          0.01          0.01          0.01          0.01          0.00
1370          3          4800.0          4000.0
1380          0.01          0.02          0.03          0.050          0.07
1390          0.10          0.11          0.10          0.09          0.09
1400          0.08          0.06          0.04          0.04          0.03
1410          0.02          0.02          0.02          0.01          0.01
1420          1000
1430          50
1440          0
1450          0
1460 /END
1470 /END
--EOR--
--END--

```

FIGURE 4-A.1
BENEFIT GAINED EQUATION

$$BG = \sum_{n=1}^{n=1RPL} PWF [PRP + LTPR + DOC + AFCC]$$

where:

$$PWF = \text{Present Worth Factor} = \frac{1}{(1 + PVIR)^n}$$

$$PRP = \text{Replacement Power Penalty (6 hours)} = \left[\frac{GMR1(HR1 \times FC1 + VC1) + GMR6(HR6 \times FC4 + VC1)}{GMR6 + GMR1} - HR5 \times FC5 \right] 6YI$$

LTRP = Long Term Replacement Power

$$= YI \times (DI - 6) \left[\frac{GMR1(HR1 \times FC1 + VC1) + GMR2(HR2 \times FC2 + VC2) + GMR3(HR3 \times FC3 + VC3) + GMR4(HR4 \times FC4 + VC2) + GMR6(HR6 \times FC4 + VC1)}{GMR6 + GMR1 + GMR2 + GMR3 + GMR4} - (HR5 \times FC5) \right]$$

$$DOC = \text{Direct Outage Costs} = \frac{YI (CRP + AOL \times DI)}{PC}$$

$$AFCC = \text{Avoidance of Future Capital Costs} = \frac{PI}{8760} \times CNP \times LAFC \times YI$$

FIGURE 4-A.1 (Continued)

GMR*	=	Generation Mix Ratio	* 1 =	Combustion Turbine Distillate
HR*	=	Heat Rate (MBTU/kWH)	2 =	Steam Turbine Oil
FC**	=	Fuel Cost (\$/MBTU)	3 =	Steam Turbine Coal
VC+	=	Variable Costs (\$/kWH)	4 =	Steam Turbine Gas
YI	=	Incidents/year	5 =	Steam Turbine Nuclear
DI	=	Incident Duration	6 =	Combustion Turbine Gas
CRP	=	Cost of Repair Parts/Incident (\$/Incident)	** 1 =	Distillate
AOL	=	Additional Outside Labor Costs/hr (\$/hr)	2 =	Residual
CNP	=	Cost of New Construction/kW (\$/kW)	3 =	Coal
LAFC	=	Levelized Annual Fixed Charge Rate	4 =	Gas
PC	=	Plant Capacity (kW)	5 =	Nuclear
IRPL	=	Remaining Plant Life (yrs)	+ 1 =	Combustion Turbine Gas, Distillate
PVIR	=	Discount Rate	2 =	Steam Turbine Gas, Oil
BG	=	Benefit Gained (\$/kW)	3 =	Steam Turbine Coal
			5 =	Steam Turbine Nuclear

Table 4-A.2

BASIC EQUATION FOR TOTAL ANNUALIZED COST

$$TAC = \frac{[(OTEC/NPIS) + PPEC + PPHC + PPIC] ALFC + AMC}{PC}$$

Where:

TAC = total annualized cost (\$/KW)
 OTEC = One time engineering cost (\$)
 NPIS = number of plants implementing this solution
 PPEC = per plant engineering cost (\$)
 PPHC = per plant hardware cost (\$)
 PPIC = per plant installation cost (\$)
 ALFC = levelized annual fixed charge rate
 AMC = annual maintenance cost due to the installation of the solution (\$)
 PC = plant capacity (KW)

APPENDIX 4-B

ASSUMED VALUES USED IN THE NET BENEFIT MODEL

4-B-i/4-B-ii

APPENDIX 4-B
ASSUMED VALUES USED IN THE NET BENEFIT MODEL

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FIGURE 4-B.1

SUMMARY OF COST BENEFIT FACTORS USED

<u>BENEFIT CALCULATION FACTORS</u>	<u>ASSUMPTION</u>	
	<u>HELD FIXED</u>	<u>UNCERTAIN</u>
FAILURE RATE		X
FAILURE DURATION		X
GENERATION MIX FOR REPLACEMENT POWER ⁽¹⁾	X	
HEAT RATES ⁽²⁾	X	
FUEL COST ESCALATED: COAL		X
GAS		X
OIL		X
NUCLEAR		X
REPLACEMENT PLANT COST ESCALATED (NUCLEAR PLANT ASSUMED)		X
LEVELIZED ANNUAL FIXED CHARGE RATE	X	
TRUE COST OF MONEY ⁽³⁾	X	
REPAIR COST		X

(1) THE NATIONAL AVERAGE MIX OF ELECTRICAL GENERATION TYPES IN THE U.S.

(2) THE AMOUNT OF HEAT NEEDED TO GENERATE A GIVEN AMOUNT OF ELECTRICITY, EXPRESSED IN MBTU/KW-HOUR

(3) THE ANNUAL RATE WHICH IS USED TO TAKE INTO ACCOUNT THE POTENTIAL EARNING POWER OF MONEY, WHILE MOVING DOLLAR AMOUNTS BACKWARD IN TIME. THE WEIGHTED COST OF CAPITAL (DISCOUNT RATE) IS USED IN THIS ANALYSIS

FIGURE 4-B.2

OUTAGE COST CALCULATION INPUT VALUES

INSTALLED GENERATION MIX RATIO (1980)*

<u>VARIABLE</u>	<u>SYMBOL</u>	<u>VALUE (%)</u>
COMBUSTION TURBINE, DISTILLATE	GMR1	6.5
STEAM TURBINE, RESIDUAL	GMR2	16.6
STEAM TURBINE, COAL	GMR3	40.4
STEAM TURBINE, GAS	GMR4	10.4
STEAM TURBINE, NUCLEAR	GMR5	10.8
COMBUSTION TURBINE, GAS	GMR6	0.6
HYDRO	NOT USED	11.1
OTHER	NOT USED	<u>3.2</u>
TOTAL VALUE:		100.0

FIGURE 4-B.3
OUTAGE COST CALCULATION INPUT VALUES

HEAT RATES OF GENERATING UNITS

<u>VARIABLE</u>	<u>SYMBOL</u>	<u>VALUE (BTU/KWH)</u>
COMBUSTION TURBINE, DISTILLATE	HR1	14,000 (1)
STEAM TURBINE, RESIDUAL	HR2	9,200 (1)
STEAM TURBINE, COAL	HR3	10,200 (1)
STEAM TURBINE, GAS	HR4	11,000 (2)
STEAM TURBINE, NUCLEAR	HR5	10,400 (1)
COMBUSTION TURBINE, GAS	HR6	15,000 (2)

(1) REFERENCE 6

(2) REFERENCE 10

FIGURE 4-B.4

OUTAGE COST CALCULATION INPUT VALUES

FUEL COST

<u>VARIABLE</u>	<u>SYMBOL</u>	<u>VALUE (\$/MBTU)</u>	ESCALATION		
			LOWER L	EXPECTED L	UPPER L
DISTILLATE (1)	FC1	3.59	0	0.01	0.07
RESIDUAL (1)	FC2	2.71	0	0.01	0.07
COAL (1)	FC3	1.23	0	0.007	0.03
GAS (1)	FC4	1.79	0	0.025	0.05
NUCLEAR (2)	FC5	0.53	0.0174	0.02	0.0226

(1) (REFERENCE 9)

(2) (REFERENCE 6)

(3) NUMBERS IN THIS COLUMN ARE YEAR ZERO VALUES. FOR FUTURE COSTS, MULTIPLY THE VALUE BY $(1+L)^N$ WHERE L IS THE ESCALATION RATE AND N THE YEARS FROM ZERO.

FIGURE 4-B.5
OUTAGE COST CALCULATION INPUT VALUES

OPERATING AND MAINTENANCE COSTS*

<u>VARIABLE</u>	<u>SYMBOL</u>	<u>VALUE (MILLS/KWH)</u>
COMBUSTION TURBINE - GAS, DISTILLATE	VC1	2.05
STEAM TURBINE - GAS RESIDUAL	VC2	0.3
STEAM TURBINE - COAL	VC3	4.16
NUCLEAR	VC4	0.72

* FROM REFERENCE 6

FIGURE 4-B.6
OUTAGE COST CALCULATION INPUT VALUES

OTHER

<u>VARIABLE</u>	<u>SYMBOL</u>	<u>VALUE (1+L)^N</u>	<u>ESCALATION</u>			<u>UNITS</u>
			<u>LOWER</u> <u>L</u>	<u>EXPECTED</u> <u>L</u>	<u>UPPER</u> <u>L</u>	
NUCLEAR PLANT CAPITAL COST	CNP	1,092	0	0.03	0.185	\$/KWe
LEVELIZED ANNUAL FIXED CHARGE RATE*	LAFC	18	0	0	0	%
TRUE COST OF MONEY*	PVIR	3.8	0	0	0	%

* MAY BE LOWER FOR UTILITIES WHICH ARE PUBLICLY OWNED.

FIGURE 4-B.7

TYPICAL PROBABILITY DISTRIBUTION FOR ESCALATION RATE (NEW NUCLEAR CONST.)

(1) Exclusive of inflation

APPENDIX 4-C

DESCRIPTION OF THE SIGMA CODE

4-C-i/4-C-ii

The SIGMA code has been developed to combine gaussian, square and other probability distributions.

The basic idea underlying the SIGMA code is the generation of data populations conforming to given probability distributions for each independent variable. Subsequently, random sampling of these data populations is done to generate the dependent variable probability distribution through use of the functional relationship. The functional relationship between the dependent variable and the independent variables is supplied by the code user.

The theoretical bases upon which this code depends are those involving the Monte-Carlo, and Stratified Sampling, techniques.

For each independent variable a set of data points is generated by the code, which corresponds to the input specification of the probability distribution associated with the independent variable. The resulting data blocks associated with each independent variable are then randomised. Finally the first data point in each data block is selected and combined according to the code user supplied functional relationship and the first resultant, or dependent variable, data point is generated. This process is continued until all data in each data block has been used. The resultant probability histogram is then printed out.

The technique involved in the generation of each independent variable data block according to the input probability distribution specifications, proceeds as follows.

1. The range of possible values for each independent variable is divided up into a user supplied number of intervals of equal width.
2. The probability that the independent variable of interest takes on values within each interval is calculated.
3. Using the total number of data points specified by the user, the number of data points in each interval is then calculated.

4. The required number of data points in each interval are then generated using a random number generator scheme embodied in the computer software for each independent variable.
5. The independent variable data block is then randomized as a whole so that the indices of a specific data point have no relationship to the magnitude of the data point, i.e., Data [2,1] and Data [2,28] have no relative magnitude relationship based on the indices 1 and 28, they are just data belonging to the 2nd independent variable data block.

APPENDIX 4-D

PROJECTED FUEL COSTS AND SENSITIVITY CURVES

APPENDIX 4-D
PROJECTED FUEL COSTS

This appendix contains fuel cost predictions used in the analysis to the year 2020. All escalation rates do not include the effects of inflation.

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FIGURE 4-D.1

PROJECTED DISTILLATE OIL FUEL COSTS (\$/MBTU)

FIGURE 4-D.2

PROJECTED RESIDUAL OIL FUEL COSTS (\$/MBTU)

FIGURE 4-D.3

PROJECTED COAL FUEL COSTS (\$/MBTU)

FIGURE 4-D.4

PROJECTED GAS FUEL COSTS (\$/MBTU)

FIGURE 4-D.5
PROJECTED NUCLEAR FUEL COST (\$/MBTU)

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