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Common Cause Fault Rates for Pumps

Estimates Based on Licensee Event Reports at U.S. Commercial Nuclear Power Plants, January 1, 1972 Through September 30, 1980

Prepared by C. L. Atwood

EG&G Idaho, Inc.

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ABSTRACT

This report presents estimates of common cause fault rates and related quantities, based on Licensee Event Reports for pumps in nuclear reactors. The Licensee Event Report data base is described. For estimating rates, the binomial failure rate model is used, extended to allow for the substantial observed plant-to-plant variability, and for shocks that by their nature make all the pumps in a system inoperable. Every quantity is estimated by both a point estimate and a 90% interval. All rates are expressed per hour.

FIN No. A6283--Licensee Event Report Failure Rate Analysis Program

SUMMARY

This report presents estimates of common cause failure rates, common cause fault rates, and related quantities, based on Licensee Event Reports for pumps in nuclear reactors.

The data consist of 837 Licensee Event Reports, describing pump faults from January 1, 1972, through September 30, 1980. The term fault includes both failures and command faults. Both pump and fault are precisely defined in the body of the report.

Two kinds of fault are considered, failure to start on demand, and failure to operate after starting. The systems considered, their relevant exposure times, and their populations are described and tabulated. Imperfections in the data are also discussed.

Common cause faults are defined as faults that are synchronized by some external shock to the system under consideration. Both human errors and hardware failures may act as shocks. The report distinguishes between a nonlethal shock, which causes a random number of pumps to be inoperable, and a lethal shock, which by its nature causes all the pumps in the system to be inoperable.

Turbine-driven pumps have high fault rates, and so must be considered separately. Examination of the data also reveals substantial variability in the fault rates from plant to plant, and to a lesser degree from system to system, for presumably similar pumps. Therefore, the rates are assumed to vary and distributions are fitted to the data, both for the rate of individual faults (those not due to common cause), and also for the rate of common cause events when there are enough data. Other quantities of interest are then estimated, based on the binomial failure rate (BFR) model, extended to allow for lethal shocks.

Every quantity is estimated by both a point estimate and a 90% interval. Many of the intervals are quite wide, reflecting the observed

plant-to-plant variability. Because the numbers of demands are unknown, and the operating hours of most pumps are unknown, the only rates estimated are per exposure hour, normally calendar hour or critical hour.

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W. H. Sullivan and M. Trojovsky patiently helped reexamine the data to ensure correct common cause classification, and made many helpful suggestions. J. P. Poloski, T. L. Cook, N. D. Cox, M. E. Stewart, and W. E. Vesely made useful suggestions.

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COMMON CAUSE FAULT RATES FOR PUMPS: ESTIMATES BASED ON LICENSEE EVENT REPORTS AT U.S. COMMERCIAL NUCLEAR POWER PLANTS, JANUARY 1, 1972--SEPTEMBER 30, 1980

INTRODUCTION

Common cause faults are defined, for this report, as faults that are synchronized by some external shock to the system. The seriousness of having several pumps simultaneously inoperable due to a single cause makes it essential to estimate the rate of pumps becoming simultaneously inoperable. Therefore, this report presents estimates of common cause and individual fault rates and failure rates, for pumps in nuclear power plants.

The data are Licensee Event Reports. They are described and discussed in the first portion of this report. Two common cause aspects of the data are considered in detail: correctly classifying reported events as common cause events or not, and deciding which groups of pumps in a plant might be susceptible to simultaneous failure due to a common cause shock.

The binomial failure rate method is used to estimate the common cause rates and related quantities of interest. Every quantity of interest is estimated both by a point estimate and by a 90% interval. Many of the intervals are rather wide, reflecting the substantial plant-to-plant variability evident in the data. A section of the report discusses how to use binomial failure rate estimates in applications such as fault tree analyses.

All the basic methodology is described in the body of the report. Certain technical details not covered in the references are given in Appendix A. The required plant information, including exposure times and pump populations, is given in Appendix B. The estimates themselves are found in Appendix C. Appendix D consists of a listing of one-line summaries of all the data, and a separate listing of summaries of the reported common cause events.

THE DATA

Event Reports

The raw data consist of 837 Licensee Event Reports (LERs) of pumps at 68 U.S. commercial nuclear power plants, for the time period January 1, 1972, through September 30, 1980, as given by Trojovsky.[1] They include reports from 44 pressurized water reactors (PWRs), i.e., those designed by Babcock & Wilcox, Combustion Engineering, and Westinghouse and 24 boiling water reactors (BWRs), i.e., those designed by General Electric Corporation. Events that occurred before a plant's initial criticality are not considered. Some errors and omissions in the data as originally published have been corrected.

One-line summaries of the data are presented in Appendix D. These summaries are also printed separately for different groups of pumps, accompanying the estimates in Appendix C. To facilitate checking for possible common cause, underscores are used to separate unrelated lines. Lines not so separated describe events that occurred at the same plant on the same date. Appendix C also contains some tabular summaries of the data, giving the total numbers of various kinds of faults.

Except for the common cause coding, the letter and number codes printed in the one-line summaries of Appendix C all have the same meanings as in Reference 1. The codes are briefly explained in a table in Appendix B. In the one-line summaries, the following information is given on each line:

Vendor This code tells whether the plant was designed by Babcock & Wilcox, Combustion Engineering, Westinghouse, or General Electric.

Plant This is a 3-character code identifying the plant.

Control Number This is the unique 6-digit identifier assigned to the LER. If a single LER refers to more than one pump or more than one date, the control number for this line has another character appended: an asterisk, or a letter A, B, C, etc.

Failure Date The month, day, and year are given.

System This code identifies the system to which the pumps belong, such as containment spray or high pressure coolant injection.

Component This tells whether the pump is motor driven, turbine driven, or diesel-driven.

Failure Mode and Cause These codes classify the kind of fault. For example the code for mode might mean does not start, while the code for cause might mean personnel error--maintenance.

Type This code tells whether the event is a failure or a command fault, whether it is an individual fault or caused by a common cause shock, and whether it is recurrent or not.

Failure Number This tells the number of pumps that were inoperable, or for a single pump, the number of times it was inoperable as reported by this line.

Activity This tells when the fault was discovered, for example, during normal operation or during maintenance.

Event Classification The likelihood of a kind of fault may depend on elapsed time or on the number of demands. This code classifies faults as time-related or demand-related, as described more fully in Reference 1.

Mode Description and Cause Description This is a very condensed narrative, from the LER.

Definitions

The definitions given here follow Reference 1. A pump is defined as the pumping unit, together with its prime mover, coupling, and associated mechanical controls. Suction and discharge valves and strainers are not

considered part of the pump. Neither are electrical instrumentation and control elements. Suppose that the cooling system of the prime mover is served by a major plant cooling water system, such as the service water or component cooling water system. That portion of the prime mover cooling system that is downstream from the major cooling water system supply valve and upstream from the major cooling water system return valve is considered part of the prime mover. The prime mover of a motor-driven pump includes the motor and the junction where the power source enters the motor casing. It does not include components upstream from this junction, such as the motor control center, supply breaker, or power supply cables. The prime mover of a turbine-driven pump includes the turbine, the mechanical controls of the turbine governor, the trip-throttle valve, and the lube-oil systems used in operating the governor system or lubricating the bearings. Anything upstream from the trip-throttle valve or downstream from the turbine exhaust is considered outside the boundary of the turbine. The prime mover of a diesel-driven pump includes the diesel engine, the mechanical controls of the governor and of the overspeed trip mechanism, and the support systems: the fuel system, the air supply and exhaust system, the lube-oil system, and the starting system. Starting batteries are outside the boundary.

Failures are distinguished from command faults. A failure is an event in which the pump itself needs repair. A command fault is an event in which the pump does not fail, but it does not function as desired due to external inputs or lack of inputs. For example, if a pump is commanded to start, but it fails to function because its feeder breaker fails or an operator fails to vent its casing, then the pump has not failed; it would operate satisfactorily if power were available or the pump were full of liquid. The term fault is used to include both failures and command faults. This report presents estimated rates based both on all faults and on failures only. To avoid needless repetition, however, the explanatory text is given just once, and is expressed in terms of faults rather than failures. Unless the context clearly rules it out, any statement about faults should be understood to apply as well to any subset of faults, such as failures.

Five failure modes, defined below, are identified in the data. Both failures and command faults can involve any of the five modes. Leakage/rupture describes a fault in which the pump is operational, but is removed from service because of excessive fluid or vapor leakage. Loss of function means that the pump was operating in a degraded condition, such as with low flow or low head. A pump does not continue to run if it is automatically or manually tripped off line to prevent damage to the pump. A pump does not start if it either fails to start on demand or else operates only briefly before tripping off line. The mode unavailable/not demanded is used for events when the pump was discovered in an inoperable condition, but it was not demanded either for operation or for a test. The codes for these five failure modes are given in Table B-4 of Appendix B. LERs describing other kinds of events are not considered in this report. For example, informational items, such as the failure to perform a test on schedule, are not considered. Neither are reports of maintenance repair, when an incipient failure was repaired before the pump had become inoperable. Because LERs normally do not mention taking a pump out of service for scheduled maintenance or inspection, when the time limit of the technical specification is not exceeded, such events are also not included in this report.

Rates for two groups of failure modes are presented in this report. The failure modes "does not start" and "unavailable/not demanded" are combined as failure to start, and this rate is estimated. The other three failure modes are combined as failure to operate after starting, and this rate is estimated. This is not a perfect grouping of the failure modes, because, for example, it is not clear whether an undemanded pump would have failed to start or tripped after running. However, no perfect grouping of the failure modes is possible, and the grouping used should be adequate.

Systems, Exposure Times, and Populations

Systems

The pumps belong to various systems, such as the auxiliary feedwater system or the containment spray system. The systems considered in this

report are listed in Table B-1 of Appendix B. Some systems are present only in PWRs or only in BWRs. Others are present in both types of reactors.

The pumps in the different systems also fall into three categories: running, alternating, and standby. Running pumps are those which are operated during the entire time of criticality. The only such pumps considered in this report are in the reactor coolant system of PWRs and the coolant recirculation system of BWRs. Alternating pumps are those which are normally operated part of the time. The system, such as component cooling water, is run continually, but only some of the pumps in the system are running at any one time. Standby pumps are intended for use only in an emergency. Except for periodic tests, they are normally not running.

The three categories of pumps characteristically show different kinds of faults. Reported faults in running pumps are virtually always failures to operate after starting. (There is only one reported failure to start in the nine years of data.) Standby pumps have somewhat more reported failures to start than failures to operate after starting. Alternating pumps have a behavior between the other two.

The systems considered in this report, and given in Table B-1, are those of Table 1 of Reference 1, except that service water pumps are left out. The term service water is vague, and its scope is not generally agreed on. This leads to both inconsistent counts of the pump populations based on plant drawings, and inconsistent reporting in the LERs. The texts of about half the LERs for service water pumps seem inconsistent with the population counts of Reference 1. Therefore, service water pumps are not considered in this report.

Exposure Times

The number of calendar hours and the number of critical hours for each plant are given in Tables B-2 and B-3 of Appendix B. They are taken from Reference 1. Each time starts with the initial criticality of the plant and ends on September 30, 1980, except for Dresden 1, which began a lengthy

shutdown, and stopped submitting LERs, on October 31, 1978, and Three Mile Island 1 and 2, which were both shut down after the accident of March 28, 1979.

To estimate fault rates, it is necessary to know the relevant exposure times, the number of hours when the pumps might be reported inoperable. Some systems, such as the component cooling water system, are run both during criticality and during shutdown, and are required for safety at all times. Therefore, LERs would be submitted for faults that occur at any time, and the relevant exposure time for such a pump is the number of calendar hours for the plant. Other systems, such as the standby liquid control system in BWRs, are required only during criticality. So the relevant exposure time for such a pump is the number of critical hours for the plant.

To determine the relevant exposure time for each system, the LERs themselves were used. The power level of the plant is supposed to be shown on each LER. If this level was zero, and if the narrative does not state that the reactor was starting up or had just tripped, then the reported event was presumed to have taken place during shutdown. Based on this classification, a sample of LERs from each system was examined, to see what fraction of the LERs report events that occurred during shutdown. If more than 20% occurred during shutdown, the relevant time for that system was taken to be calendar hours. If fewer than 10% occurred during shutdown, the relevant time was taken to be critical hours. (The total number of shutdown hours for all the plants is about 30% of the total number of calendar hours.) Every system was classified in this way with the following exceptions.

Turbine-driven pumps can only be operated when the plant is producing steam. Therefore the turbine-driven high pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) pumps in BWRs were taken to have the critical hours of the plant as the relevant exposure time. Because PWR auxiliary feedwater systems typically contain at least one turbine-driven pump, critical hours were also taken as the exposure time for all auxiliary feedwater pumps, whether turbine-driven or not (exactly 7 of the 35 faults

in motor-driven auxiliary feedwater pumps occurred during shutdown; to use critical hours rather than calendar hours raises the estimated fault rate somewhat, but greatly simplifies the common cause calculations, when the whole auxiliary feedwater system must be considered as a unit). Finally, for pumps that serve for both low pressure coolant injection (LPCI) and residual heat removal (RHR), the pump was defined as an LPCI pump if the reactor was critical and as an RHR pump if the reactor was shut down. The exposure time is then taken to be critical hours for LPCI pumps and shutdown hours for RHR pumps.

Table B-1 shows the exposure times used in this report for estimating fault rates.

Rates of failure to start are normally presented as rates per demand instead of rates per hour. However the number of demands is unknown. Those who can estimate the average number of demands per hour can convert the rates of this report. Variation in the number of demands may contribute to the substantial apparent plant-to-plant variability in the fault rates.

For alterating and standby pumps, rates of failure to operate after starting are normally presented in terms of operating hours. Unfortunately, the fraction of time when these pumps are operating is unknown. Again, the user must supply a conversion factor.

Populations

The number of pumps in each system at each plant is given in Tables B-2 and B-3 of Appendix B. They are taken from Reference 1, and have been corrected in a few cases. The ultimate sources of the populations are the drawings in the individual plant Final Safety Analysis Report.

Imperfections in the Data

Not all faults in a plant are reported in LERs, and the strictness of the reporting policy may vary from plant to plant. It is not known how

much of the observed plant-to-plant variation is due to differences in reporting strictness.

There may be a few inaccuracies in the listed pump populations.

Two missing elements in the data are the number of demands on the pumps and the number of operating hours for the pumps. These numbers may vary greatly from plant to plant, and contribute to the apparent variability in the fault rate per hour; however, they are unknown. Therefore, fault rates per demand or per operating hour cannot be estimated.

Finally, the LERs sometimes provide incomplete information, especially concerning the cause of the failures. This may lead to incorrect classification of the event in the data base. A letter is often written to follow up the LER. This was read whenever a one-line description or event classification was questioned, and the coding of the event was changed if appropriate. To minimize the effect of possible misclassifications, every event involving more than one pump or involving a common cause fault was checked at least twice. The effect of data misclassification is discussed at the end of the next section. Also, an attempt is made in Appendix A to assess the effect of missing data, by using derivatives of the parameter estimates. Although it is beyond the scope of this report to estimate the number of events unreported in the LERs, the derivatives of Appendix A can be used to approximate the effect of any presumed rate of underreporting (see the Effect of Data Inaccuracies section).

COMMON CAUSE CLASSIFICATION

In order to estimate the rate of common cause faults, it is necessary to determine which events in the data base are common cause faults and which are not. The crucial question for each event is: "Was there some shock, external to the pump(s) under consideration, that caused or could have caused simultaneous faults?" Synchronization of the faults is essential, because the importance of common cause faults stems from the seriousness of having several pumps simultaneously inoperable.

For example, at Beaver Valley on April 11, 1980, two of the three residual heat removal (RHR) pumps could not develop adequate flow, because they were airbound. The shock was air getting into the water, so that it could pass through the pipes to the RHR pumps. At Turkey Point 3 on May 8, 1974, two of the three auxiliary feedwater pumps failed to start because their packing was too tight. The shock was the improper maintenance that they received. At St. Lucie 1 on May 16, 1977, all four reactor coolant pumps became inoperable when off-site power was lost. Here the shock was the loss of power.

Notice that in the first two examples, the number of inoperable pumps was random--an air leak or improper maintenance on the packing could potentially have affected a different number of pumps. The third shock, however, was lethal--by its very nature it caused all the pumps in the reactor coolant system to be inoperable. In a later section, it will be necessary to distinguish between lethal and nonlethal shocks.

Because most shocks affect a random number of pumps, there may be a shock causing exactly one pump to be inoperable. When the data are examined, it is usually possible to decide whether the single pump failed on its own, or because of some shock that could potentially have caused other pumps to fail. For example, air binding may affect one pump or several related pumps. Therefore all events involving air binding are coded as common cause. As another example, at Davis-Besse on September 15, 1978, a component cooling water pump tripped because the person responsible had not reopened a heat exchanger outlet valve. The shock in this case was

the person working with the valve positions. It could potentially have caused additional pumps to be inoperable (indeed, at Brunswick 2 on September 7, 1980, incorrect line-up of the stop-check valves did affect the RCIC pump and the HPCI pump simultaneously). Correct identification of common cause shocks as the causes of these single failures helps in estimating the rate at which shocks occur. If such events were ignored, then few common cause events would remain to be used, and the statistical uncertainties in the estimates would be much larger than necessary.

Faults due to personnel error are often coded as common cause. For a personnel error affecting only one pump to be coded as common cause, it must be plausible that in similar circumstances, e.g., at another time or at another plant, the person could make the same mistake affecting more than one pump at the same time. This is the case in the above example with an improper valve line-up. But it is not the case with all personnel errors. For example, inadequate lubrication would result in a high failure rate, but not in synchronized failures. As another example, at Davis Besse on May 28, 1978, an operator accidentally bumped a diesel generator control switch. This de-energized two electrical buses, so that the operating decay heat pump lost its power. There apparently was immediate annunciation of the problem, because power was restored within two minutes. Therefore it is very unlikely that the operator could have gone on to bump a second switch, so the event is not coded as common cause. As a final example, at Rancho Seco on February 18, 1977, it was noticed that the steam drive to the turbine-driven auxiliary feedwater pump was tripped. Nearly all PWRs have only one steam-driven auxiliary feedwater pump. Therefore, there would be no second pump that could potentially have been affected, so the event is not coded as common cause.

Multiple failures are coded as common cause only if they appear to be synchronized rather than coincidental. As a case in point, consider an event at Beaver Valley on December 15, 1976. Two pumps developed leaks in their lube oil coolers, caused by erosion from particles in the river cooling water. The leaks were discovered about 11 hours apart. If the particles were unusual, and caused essentially immediate failure, then the

failures were synchronized and should be classified as common cause. However, the word erosion suggests a gradual wearout, with no synchronization. It seems plausible that in the environment of dirty water the lube oil coolers have a high failure rate, but fail independently. Why then did the two fail on the same day, if presumably it takes months for the leaks to develop? A likely explanation is that when the plant personnel saw one leak they went looking for others. Therefore, the events are classified as two recurrent individual failures, rather than as one common cause event.

Suppose that all the pumps in a system, for example all the containment spray pumps, were inoperable due to common cause. Such an event is coded as a lethal shock only if the shock by its nature automatically made all the pumps inoperable. That is, under similar circumstances, even at a plant with a different number of pumps in the system, all the pumps would again be inoperable. The most common example in the pump data is loss of power to the reactor coolant pumps. A lethal shock can also occur when a person, through misunderstanding or forgetfulness, intentionally takes the same (wrong) action repeatedly, rendering all the pumps inoperable. For example, at Robinson 2 on November 23, 1977, during a startup, the circuit breakers were found racked out for all three HPCI pumps and both containment spray pumps. Someone had tested the pumps for operability and then racked out the breakers again.

As can be seen, the coding of common cause events involves some judgement on the part of the coder. An inadvertent experience with diesel generator data, described by Atwood and Steverson,[2] sheds some light on the importance of the coder's judgement. After all the estimates had been calculated, Atwood and Steverson reexamined the diesel generator data, and changed the common cause coding of eight faults, each involving one diesel generator. Two failures became common cause; five command faults became common cause command faults; and one common cause command fault became not common cause. So there was a net increase of six common cause faults, each involving only one diesel generator. This was in a data base of 369 LERs, with 25 events initially coded as common cause. Of the estimates that would be used in a fault tree, one of them, r_2, changed by almost 25%. This is about 5% of the length of the interval for r_2. The changes are

smaller for the other quantities that would be used directly in fault trees. This suggests that the coder's judgement has a noticeable but not overriding effect. There is no a priori reason to believe that pump data is more difficult or less difficult to code than diesel generator data, so the experience reported in Reference 2 is probably relevant for this report.

EXAMINING THE DATA FOR STRUCTURE

The Scope of Common Cause Events

Nearly all of the common cause events in the data are restricted to a single system, for example, to the residual heat removal system or the component cooling water system. These events are also the ones of greatest interest in a probabilistic risk analysis, since the pumps in a single system back each other up.

There are, however, some reports of common cause events that involve more than one system. These events are shown in Table 1. Not shown in Table 1, or included in the pump data, are any events when a power supply to a pump was de-energized while the pump was not demanded. It would be cumbersome to try to present common cause fault rates for all the kinds of events suggested by Table 1. Most of the systems in Table 1 perform distinct functions, so their possible common cause connections are not of great interest, and are not considered further in this report. The pairs of systems that are considered are the HPCI and chemical and volume control (CVC) systems in PWRs, and the HPCI and RCIC systems in most BWRs. The HPCI and CVC systems in PWRs are considered together because they could both be used to mitigate a small-break loss-of-coolant accident. Rates are presented treating these two systems like all the other systems. Then in addition, rates are presented based only on the data from the two systems, with the two considered as a single pooled system. The other two systems that are pooled are the HPCI and RCIC systems in those BWRs (all but seven) having a single turbine-driven HPCI pump and a single turbine-driven RCIC pump. These two pumps often seem to be maintained together and tested together, so it is reasonable to treat them as a single system.

The events in Table 1 are coded in the data base as common cause only if they are common cause within the single system under consideration. For example, the incorrect substitute breaker event is coded as three nonlethal common cause events, one in each of the three systems, because it is plausible that more pumps might have been affected in each system. The event with the common valve is not coded as common cause, because the valve

TABLE 1. COMMON CAUSE EVENTS INVOLVING MORE THAN ONE SYSTEM

Plant	Control No.	Date	Systems	Description
OE1	014806	1/28/76	L, F, G	Incorrect substitute breakers were installed for one LPCI pump, one containment spray pump, and one HPCI pump.
OE2	011071	12/9/74	L, F	Common suction valve was closed for one LPCI pump and one containment spray pump.
RO2	019793	11/23/77	H, F	Breakers for all 3 HPCI pumps and both containment spray pumps were racked out.
SA1	017700	5/6/77	H, G	Both HPCI pumps and one chemical and volume control pump were tagged out.
SA1	023232	11/27/78	G, L	One chemical and volume control pump and one RHR pump did not start, because of an electrical bus failure.
BF1	000518	11/10/73	H, Q	The HPCI and RCIC pumps were inoperable until manually reset, because of improper trip logic.
BR2	032454	9/7/80	H, Q	Stop-check valves were shut for both the HPCI and RCIC pumps (the RCIC pump tripped; the HPCI pump was not demanded).

failed internally, and it was not connected to more than one pump in a system. The case of the racked-out breakers is coded as two lethal shocks, one for HPCI and one for containment spray, because the personnel error by its nature affected all the pumps in each system.

In summary, common cause events are considered only within a single system, except that turbine-driven HPCI and RCIC pumps in BWRs are considered as a single system, and HPCI and CVC pumps in PWRs are considered both separately and as a single pooled system.

Variability in the Fault Rates

Experienced engineers know, and the LERs confirm, that turbine-driven pumps have higher fault rates than motor-driven pumps. Therefore, systems with turbine-driven pumps must be treated separately. These are the HPCI and RCIC systems in all but five of the BWRs, and the auxiliary feedwater system in PWRs. The auxiliary feedwater system usually has one turbine-driven pump and two motor-driven pumps, although these numbers vary.

Because of this consideration, and those of the previous section, there are six groups of pumps for which fault rates are presented. These groups are listed in Table 2.

Within any of these groups of pumps, the fault rates show substantial plant-to-plant variability. There is also some variation in the rates from

TABLE 2. GROUPS OF PUMPS FOR WHICH FAULT RATES ARE ESTIMATED

Running Pumps:	Reactor coolant/recirculation pumps
Alternating Pumps:	PWR chemical and volume control (CVC) pumps BWR feed pumps that serve for HPCI (4 plants) PWR boric acid transfer pumps Component cooling water pumps Residual heat removal (RHR) pumps
PWR Auxiliary Feedwater Pumps	
BWR turbine-driven HPCI and RCIC pumps (treated as one system)	
Other Standby Pumps:	BWR low pressure core spray pumps Containment spray pumps PWR high pressure coolant injection (HPCI) pumps Low pressure coolant injection (LPCI) pumps BWR standby liquid control pumps
PWR HPCI and CVC pumps (treated as one system)[a]	

a. These two systems are pooled here, in addition to being considered separately above.

system to system. For example, the five systems classified as alternating show some apparent differences in their fault rates. But the plant-to-plant variability is dominant, as discussed below.

As a first step in estimating fault rates, the variability in the rates must be quantified. Suppose that the variability in some fault rate is to be modeled. The rate may be the rate of nonlethal common cause events, the rate of individual (i.e., not common cause) events, or if enough data are available the rate of lethal common cause events. The data sources are the different systems at the different plants, for example the five alternating systems at the 68 plants. To model the variation among the different plants and systems, assume that the rate has a two-parameter gamma distribution. A gamma distribution is used because it is a convenient distribution covering the range $(0,\infty)$. Some other distribution, such as lognormal, might work equally well. Based on the observed faults, find the maximum likelihood estimates of the two unknown parameters. This gives a gamma distribution that fits the data. An interval covering 90% of the fitted distribution is an approximate 90% interval for the fault rate. That is, the probability that such an interval will include a randomly chosen new fault rate (say, from a system at a plant not yet analyzed) is approximately 90%.

It is conceivable that the fault rate is strongly influenced by the type of plant (BWR or PWR), or by the system. For example, treating the alternating systems separately might result in five short tolerance intervals, covering different ranges, rather than one long tolerance interval. Although such a breakdown might conceivably help, in fact it does not. Therefore, system-specific rates are not given, except to the extent that single systems coincide with the groups given in Table 2.

Typically, most of the plants show no faults, while a few may show recurrent faults. This results in highly skewed fitted distributions, having a maximum at zero, a long flat tail to the right, and a 90% interval that is orders of magnitude wide. While such a distribution is not what a risk analyst desires, it does reflect the great variability in the data.

Occasionally a single plant or system has so many recurrent faults that it is an outlier, i.e., it is clearly different from the other plants. The most extreme example is the turbine-driven auxiliary feedwater pump at Arkansas 2. However, no outliers are so far out that they have to be excluded. For details, see the first section of Appendix A.

ESTIMATING RATES USING AN EXTENDED BINOMIAL FAILURE RATE MODEL

The Model

Let m be the number of pumps in a system at a plant. The model assumes that there are three possible kinds of fault:

1. Each pump can become inoperable individually, and has a constant fault rate λ.

2. A common cause shock can occur in the system, with constant occurrence rate μ. If a shock occurs, the pumps in the affected system are made inoperable independently of each other, each with probability p, so the total number of inoperable pumps is random. Vesely[3] calls this the binomial failure rate (BFR) model, because the number of inoperable pumps, given that a shock occurs, is a binomial(m, p) random variable. Estimators using this model are developed by Vesely[3] and Atwood.[4,5] These shocks are called nonlethal shocks, to distinguish them from the shocks defined below.

3. A lethal shock can occur in a system, with constant occurrence rate ω. A lethal shock, by its very nature, causes every pump in the affected system to be inoperable. The number of inoperable pumps is not random, but must equal m. Such events normally involve a procedural error or a personnel misunderstanding, or some hardware failure to the whole system, such as loss of offsite power.

Some quantities of interest are listed below. The notation for p, λ, and μ agrees with Reference 4. The quantity λ_+ is called λ'_+ in that reference. The quantities are

λ = fault rate for an individual pump, not counting faults due to common cause shocks

μ	=	rate of nonlethal shock occurrences
p	=	probability that a specific pump is inoperable, given that a nonlethal shock occurs
$\lambda_+ = \mu(1 - q^m)$	=	rate of nonlethal shocks that cause at least one pump to be inoperable (rate of visible nonlethal shocks). Here, $q = 1 - p$
ω	=	rate of lethal shock occurrences
$r_1 = \lambda + \mu p + \omega$	=	rate at which a specific pump becomes inoperable, either as an individual fault or due to a shock
$r_k = \mu p^k + \omega$ for $k \geq 2$	=	rate at which a specific set of k pumps becomes inoperable simultaneously (due to a shock)
$\beta = [\mu p(1 - q^{m-1}) + \omega]/r_1$	=	long-term fraction of pump faults that occur in multiple faults; called the beta factor by Fleming.[6]

The quantities r_1, r_2, . . . are the relevant rates for fault tree analysis. For, if a cut set of a fault tree involves k pumps, $k \geq 1$, then the relevant rate is r_k, and the probability that the k pumps all fail in a short time t is $r_k t$ plus terms of order t^2. The use of r_1, r_2, etc., is discussed in the Application section, and in Appendix A. The expression given for β ignores the time for discovery and repair of faults.

The basic binomial failure rate model, as defined in Reference 3, does not include lethal shocks. Including them has two advantages. First, it

models the data more accurately, if lethal shocks are observed, without making the model much more complicated. Second, inclusion of the lethal shock rate, ω, puts a floor underneath the estimates of r_k, below which they cannot sink. The basic BFR method would estimate r_k as μp^k, for $k > 1$. If p is small and k is large, then μp^k can be microscopic. Using $r_k = \mu p^k + \omega$ keeps r_k up at a realistic level, because the Bayes estimate of ω is always positive (even when the observed number of lethal shocks is zero).

Estimation

This section briefly describes the estimation procedure based on the above model. The Bayesian methods developed by Atwood[4,5] are used, extended to allow for plant-to-plant variation and lethal shocks.

The point estimates given are Bayes means. The mean is used, rather than the mode or the median, because it is usually the largest of the three, and in fact often the only one of the three that is not virtually zero. The median is used for β, because it is expensive and difficult to compute the mean. It should be realized that when the distribution has a large variance, then no single point--be it median, mean, or some other point--adequately identifies the location of the distribution. The interval estimates given are Bayes 90% intervals, with a 5% probability in each tail.

The use of Bayesian methods is unavoidable, because classical non-Bayesian methods do not give confidence intervals for complicated expressions such as r_1, or even for simple expressions such as p when the data are obtained from plants with different numbers of pumps. The Bayesian distributions used are either estimated directly from the data, to reflect the apparent variability in the parameters, or else are calculated in the usual way based on diffuse prior distributions. Therefore, the results obtained should not differ markedly from non-Bayesian results, if the latter were obtainable.

First, a gamma distribution is fitted to the observed individual faults of the pumps. This was described in Examining the Data for Structure and defines a distribution for the parameter λ. Similarly, if enough faults are observed, a gamma distribution is fitted to the observed nonlethal common cause events, giving a distribution for the parameter λ_+. For reactor coolant/recirculation pumps, there are enough observed lethal shocks so that a distribution for ω can also be estimated.

Any variability in p, from plant to plant or shock to shock, is not estimated, because a method for doing this has not been developed. Therefore, standard Bayesian methods are used to get posterior distributions for p, and for λ_+ and ω when few or no common cause events occurred. For p, an approximately noninformative prior distribution is used, as described in Reference 5, pp. 16-17. For λ_+ and ω, a noninformative prior distribution is used, proportional to $\lambda_+^{-1/2}$ or $\omega^{-1/2}$.

The quantities μ, λ, λ_+, and ω are treated as fundamental. The distributions of all the other quantities are obtained from the distributions of the four fundamental quantities, using the equations relating the parameters in the preceding section. Unfortunately, these equations involve m, the number of pumps in the system in question. Therefore, estimates of μ, β, and r_k, $1 \leq k \leq m$, are found separately for each value of m. Then overall estimates are given, which do not depend on m, as follows. As a point estimate, the median of the point estimates is used (if the number of point estimates is even, the larger of the two pos- sible medians is used). As a conservative interval, the smallest lower bound and the largest upper bound are used.

THE ESTIMATES

The estimates are given in Appendix C, for the six groups of pumps listed in Table 2.

Rates are estimated for two failure modes: "failure to start," based on LERs coded "does not start" and "unavailable/not demanded;" and "failure to operate after starting," based on LERs coded "leakage/rupture," "loss of function," and "does not continue to run." For running pumps, i.e., reactor coolant or recirculation pumps, only rates based on the second failure mode are given.

Depending on the application, command faults may or may not be of interest. Therefore, each set of estimates includes both estimates based on all faults and estimates based on failures only, with command faults excluded.

Every estimate is given as a triple of numbers, showing the lower limit, the point estimate, and the upper limit. The point estimate is the mean of the Bayes posterior distribution (for the beta factor, the median rather than the mean is shown). The upper and lower limits form a 90% interval. Application of the estimates is discussed in the next section.

Appendix C also contains summaries of the data used to produce the estimates, both tabular summaries and printouts of the one-line summaries of the LERs. A few comments precede each set of estimates.

DISCUSSION

Application

All the rates given are per exposure hour. Many users will want rate of failure to start to be expressed as faults per demand, and rate of failure to operate after starting to be expressed as faults per operating hour. The numbers of demands on the pumps and the numbers of operating hours are not known, so the user must perform any conversion of the rates given here.

The uncertainty intervals should be used, not just the point estimates. Because of the great variability from one plant to another, many of the intervals are quite wide, so use of the point estimate alone would be overly naive. In some cases the lower bound is many orders of magnitude less than the point estimate. This happens when most of the plants or systems show no faults, but some of them show several faults. In such cases the distribution has a spike at zero and a very long flat tail. So the lower bound should be regarded as unknown, but essentially zero, and the point estimate should be thought of as a crude way to characterize a wide distribution.

Now consider the effect of delayed discovery of faults. Suppose that a pump becomes inoperable during a time interval t, but that the fault is not discovered until the pump is tested at the end of the time interval. Faults in the other pump(s) are also not discovered until the end of the time interval. If the interval is long enough, then a substantial portion of the simultaneous faults might not be common cause faults, but rather might be individual faults that were not discovered promptly.

A section of Appendix A gives the general method for using the estimated rates to estimate probabilities, for example, the probability that at least three out of four pumps become inoperable during a time period t. Using the general method, approximations can be found if t is not too large, such as

$$P(\text{1 specific pump inoperable}) \doteq r_1 t$$

and

$$P(\text{k specific pumps inoperable}) \doteq (\lambda t)^k + r_k t$$

for $k \geq 2$. These approximations are accurate to at least one significant digit if, in the first case, $r_1 t < 0.1$, and in the second case if $\lambda t < p/10$ and $r_k t < 0.1$. If t is too large for these approximations, then the more general methods of Appendix A should be used. For example, this would be necessary if turbine-driven pumps are under consideration, r_1 is the upper end of the 90% interval, and t is 720 hours (1 month).

The formulas just given should look familiar to fault tree analysts. In particular, if k = 2, $r_2 t$ is used in the way that $\beta r_1 t$ is often used by analysts. The formulas given here are more general than those obtained by the beta-factor method, because they recognize that systems can have more than two pumps. The ratio r_k/r_1 would be a beta factor for k components, and the value given in this report as <u>the</u> beta factor is a compromise among these values.

It is instructive to compare the sizes of λ and r_2. For two specific pumps in time t, the probability that both pumps become inoperable because of a common cause shock is approximately $r_2 t$. The probability that both become inoperable individually is approximately $(\lambda t)^2$. For various t, these probabilities may be compared. As an example, consider failures to start in standby pumps, counting all faults. The data contain 10 common cause events in which two or more pumps in the same system were simultaneously inoperable, and one event in which two pumps in a system were inoperable apparently by coincidence. Therefore we might ask what time period between demands, t, would make $(\lambda t)^2/r_2 t$ equal to 1/10. The answer, based on the point estimates in Appendix C, is

$$t = (1/10)(6.7E\text{-}7)/(3.1E\text{-}6)^2 = 6972 \text{ hr} = 290 \text{ days}.$$

This is unrealistically large. If instead of the point estimates, we use the lower limit for r_2 and the upper limit for λ, we get

$t = (1/10)(2.7E\text{-}7)/(1.3E\text{-}5)^2 = 160$ hr = 6.7 days.

This is well under one month, so probably somewhat less than the actual average time between demands. (See Reference 1, pp 16-17.) Therefore, if we take into account the uncertainty in the estimates, this portion of the data is not inconsistent with the estimates given in Appendix C.

The beta factor is defined as the long-term fraction of pump faults that occur in multiple faults. However, to estimate it, with uncertainty bounds, the computer program uses a formula for β that assumes immediate discovery and repair of faults. Therefore the computed point estimates are low. The fact that medians are used rather than means may also make the point estimates low. For comparison, a simple direct estimate can be obtained by dividing the observed number of faults that occurred in multiple faults by the observed total number of faults. For failures to start in standby pumps, the direct estimate is 31/101 = 0.307, which hardly differs from the computed estimate of 0.297. For failures to operate in running pumps, the direct estimate is 38/109 = 0.349. This differs substantially from the computed estimate of 0.016, but is still far less than the computed upper bound of 0.850. In any case, this report recommends using r_2, r_3, etc., rather than β.

Diagnostic Checks

A diagnostic check looks for an indication that the data do not fit the assumed model. Three checks are considered here. Two are based on the internal consistency of the estimates, while the third is based on residuals. None of the checks shows strong evidence of lack of fit.

Consider the estimates for PWR HPCI and CVC pumps, pooled as one system. The estimated rates for two, three, and four simultaneous faults (r_2, r_3, and r_4,) are very slightly smaller when all faults are used than when only failures are counted. Of course the true rates based on all

faults cannot be smaller than the true rates based on only failures. The slight inconsistency arises because there are only three reported events involving more than one pump simultaneously. Because the rates are based on very little data, they can be somewhat inconsistent. The inconsistency is extremely small.

It is not uncommon for the estimate of the shock rate, μ, to be larger when based on only failures than when based on all faults. It is impossible for the true value of μ to be larger when only failures are considered than when all faults are considered. The estimates behave this way when a larger fraction of command faults than failures involve more than one pump simultaneously. It is quite possible that, with enough data, it would be better to estimate separate values of μ and p for failures and for command faults. However, with the present amount of data, it is not conclusive that the data behavior represents anything more than random variation. In any case, the estimate of μ is not used directly in fault trees. Therefore we do not pursue the matter further.

A final diagnostic check on the BFR assumptions is performed. The statistical details are given in Appendix A, but the idea of the check is as follows; if the BFR assumptions are correct, then the number of pumps affected by any (future) nonlethal shock is a binomial(m, p) random variable. Once p has been estimated, the observed numbers of affected pumps can be compared with the numbers predicted by the BFR assumptions. If they differ greatly, then the BFR assumptions should be questioned. The comparisons are performed by looking at the standardized residuals, defined as

(observed number - expected number)/standard deviation.

There is one residual for the number of common cause events involving exactly one pump, one residual for the common cause events involving exactly two pumps, etc. If the BFR assumptions are correct for the data set, then all the residuals should be small.

The largest standardized residual obtained in this way occurs when standby pumps are analyzed, based on failures to start, counting all faults. There are up to eight such pumps in a system. The standardized residuals corresponding to one through eight inoperable pumps are, respectively, -0.60, 1.19, -1.00, -0.42, -0.20, -0.09, -0.03, and -0.01. The largest absolute value is approximately 1.2. This means that no observed count is more than about 1.2 standard deviations from its estimated expected value. The residuals are even smaller in the other portions of the data. Therefore, this investigation finds no evidence of departure from the binomial distribution.

CONCLUSIONS

Estimates have been found for common cause fault rates, common cause failure rates, and related quantities. The estimates are based on Licensee Event Reports for pumps from January 1, 1972, through September 30, 1980. Because the LER data base may be incomplete, the estimates should be used with care. The numbers of demands and the operating hours are unknown for alternating and standby pumps. Therefore, all the rates presented are per exposure hour, usually critical hour or calendar hour. The user must perform any conversion to other units.

Every quantity has been estimated by both a point estimate and a 90% interval. The width of the intervals reflects both statistical uncertainty, due to the random nature of the data, and also the actual substantial variability in the fault rates from plant to plant or system to system.

How to use the estimates in applications has been discussed. Diagnostic checks showed no marked departure in the data from the assumptions of the model.

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APPENDIX A
TECHNICAL DETAILS OF METHODOLOGY

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TECHNICAL DETAILS OF METHODOLOGY

Fitting a Gamma Distribution to the Data

Suppose that λ has a gamma(a, b) distribution, and that, given λ, the number of faults of a pump has a Poisson(λt) distribution. Then it is not hard to show that the unconditional distribution of the number of faults is negative binomial with parameters a and bt (see Johnson and Kotz[A-1]). Therefore, the maximum likelihood estimates of a and bt can be found numerically, based on the exposure times and observed failures for the pumps.

To illustrate this, consider the individual failures to operate after starting, for turbine-driven auxiliary feedwater pumps in PWRs. There are 44 PWRs, but the Turkey Point Units 3 and 4 share all their turbine-driven auxiliary feedwater pumps, so they are regarded as a single plant for this investigation. The parameter λ is considered to vary among the 43 plants, but not from pump to pump within a plant.

When a gamma distribution is fitted to the data, counting both failures and command faults, the estimated parameters are 0.395 and 1.140E-4, the estimated mean of the distribution is 4.504E-5, and the estimated 90% interval is (4.303E-8, 1.879E-4). The single turbine-driven pump at Arkansas 2 (AR2) had 7 faults in 7068 hours. If a and b were equal to their estimates, the probability of getting at least 7 faults in 7068 hours would be only 0.00064. Therefore, the probability that at least one of the 43 plants would be as extreme as this is approximately 43 x 0.00064 = 0.028. In fact AR2 is influencing the estimates of a and b, so this calculation makes AR2 look better than it is. Using estimates based on all the plants except AR2 gives 43 x 0.000015 = 0.0006 as the probability of seeing a plant as extreme as AR2. Clearly, AR2 is an outlier.

If AR2 is excluded, and a gamma distribution is fitted to the remaining data, the estimated parameters are 0.682 and 4.249E-4, the estimated mean is 2.896E-5, and the estimated 90% interval is (4.557E-7, 9.951E-5).

That is, the mean shrinks by 36% (or by 9% of the length of the original interval), and the upper end point shrinks by 47%.

These changes are substantial. However it would be complicated to present a set of rates with AR2 included, another set with AR2 excluded, and another set based on AR2 only, leaving it to the reader to decide which set to use. Therefore, only one set is given, with AR2 included. This gives the conservative larger values. In Appendix C, where the estimates are given, there are some comments on how to adjust the estimates to remove the effect of AR2.

The above case was chosen to illustrate the method because it has the worst outlier problem. No other portion of the data has an outlier that is even close to as bad as AR2 in the above data.

How to Obtain Probabilities from Rates

When using the model of this report, the key to evaluating probabilities is to condition on the number of nonlethal shocks. Let N_S be the number of nonlethal shocks, and N_L the number of lethal shocks. Consider any event involving the failure or survival of certain pumps in some time period t. Let $P(A|B)$ denote the conditional probability of A, given B. The following decompositions hold:

$$P(\text{event}) = P(\text{event} \mid N_L > 0)\, P(N_L > 0) + P(\text{event} \mid N_L = 0)\, P(N_L = 0)$$

$$P(\text{event} \mid N_L = 0) = \sum_{n=0}^{\infty} P(\text{event} \mid N_L = 0, N_S = n)\, P(N_S = n).$$

Normally only the first few terms in the sum need to be evaluated.

The model assumes independent shocks with a constant shock rate. Therefore (Reference A-1, Ch. 4.1), the number of shocks in time t is a

Poisson random variable, with parameter equal to t times the shock rate. It follows that some of the above probabilities are easy:

$$P(N_L = 0) = e^{-\omega t}$$

$$P(N_L > 0) = 1 - e^{-\omega t}$$

$$P(N_S = n) = e^{-\mu t} (\mu t)^n / n!$$

If t is small, these expressions can be approximated by even simpler ones.

The nontrivial term to evaluate is the conditional probability of the event under consideration, given that $N_L = 0$ and $N_S = n$. As a major step towards evaluating this, let $q = 1 - p$, and note that for any specific single pump

$$P(\text{survival} \mid N_L = 0, N_S = n) = q^n e^{-\lambda t}.$$

This expression is the probability that the pump survives all n shocks (q^n), times the probability that it does not become inoperable individually ($e^{-\lambda t}$). Denote this expression by Q_n. To find $P(\text{event} \mid N_L = 0, N_S = n)$, use Q_n and the fact that, given a shock, the pumps behave independently.

As an example, suppose that a system has four pumps. What is the probability that at least three of the four become inoperable during some time period t? Given that $N_L = 0$ and $N_S = n$, the conditional probability that a specific pump survives is Q_n, so the conditional probability that at least three fail to survive is

$$P(\text{exactly 3 fail} \mid N_L = 0, N_S = n) + P(\text{exactly 4 fail} \mid N_L = 0, N_S = n)$$

$$= \binom{4}{3}(1 - Q_n)^3 Q_n + (1 - Q_n)^4 = (1 - Q_n)^3 (1 + 3 Q_n).$$

Therefore, to obtain the desired probability, observe that $P(\text{event} \mid N_L > 0) = 1$, and substitute into the equation for P(event) at the beginning of this section. The answer is

$$(1 - e^{-\omega t}) + e^{-\omega t} \sum_n (1 - Q_n)^3 (1 + 3 Q_n) e^{-\mu t} (\mu t)^n / n! \ .$$

Substitution of estimates for p, μ, λ and ω yields an estimate of the desired probability. To obtain upper and lower uncertainty bounds on the probability is not so easy. Using the end points of the 90% intervals for p, μ, λ and ω is conservative, since it is unlikely that the four parameters are all at their upper ends or all at their lower ends. In principle, a Bayes 90% interval can be found, based on the distributions of p, λ, λ_+, and ω. This is how the intervals for β, r_1, r_2, etc., are found in this report. To perform this operation, however, requires numerical integration.

The point estimate obtained by substituting the Bayes means into some complicated expression is not necessarily the same as the mean of the Bayes distribution of the expression. But it is simple, and credible.

When t is not large, simple approximations can be used. Each of the approximations given here is valid if $\lambda t << 1$, $\mu t << 1$, and $\omega t << 1$. They follow from the Taylor series expansion for e^{-x} and are

$$e^{-\omega t} \doteq 1$$

$$1 - e^{-\omega t} \doteq \omega t$$

$$e^{-\mu t} \doteq 1$$

$$Q_n \doteq q^n$$

$$1 - Q_n \doteq (1 - q^n) + q^n \lambda t$$

$$\sum_{n=1}^{\infty} (1 - Q_n)^i \, Q_n^j \, P(N_S = n) \doteq (p + q\lambda t)^i \, q^j \, \mu t, \quad \text{for } i \geq 0 \text{ and } j \geq 0.$$

This leads to simple approximations of many probabilities. For each of the probabilities below, the first approximation is valid if $\lambda t << 1$, $\mu t << 1$, and $\omega t << 1$. The second approximation for one specific pump is valid if in addition $\mu << \lambda$ and $\omega << \lambda$. The second approximation is valid for k pumps if the first approximation is valid and in addition $q\lambda t << p$.

$$P(1 \text{ specific pump fails}) \doteq \lambda t + p\mu t + \omega t \equiv r_1 t$$
$$\doteq \lambda t$$

$$P(k \text{ specific pumps fail}) \doteq (\lambda t)^k + (q\lambda t + p)^k \, \mu t + \omega t$$
$$\doteq (\lambda t)^k + p^k \mu t + \omega t \equiv (\lambda t)^k + r_k t \quad \text{for } k \geq 2$$

$$P(\text{at least k out of m pumps fail})$$

$$\doteq \binom{m}{k}(\lambda t)^k + \mu t \sum_{i=k}^{m} \binom{m}{i}(q\lambda t + p)^i \, q^{m-i} + \omega t$$

$$\doteq \binom{m}{k}(\lambda t)^k + \mu t \sum_{i=k}^{m} \binom{m}{i} p^i \, q^{m-i} + \omega t$$

$$\text{for } k \geq 1 .$$

Diagnostic Check Based on Residuals

If the binomial failure rate (BFR) assumptions hold, then the number of pumps affected by an observable shock has a binominal(m, p) distribution, truncated because zero cannot be observed. Once p has been estimated, the correctness of this distributional assumption can be studied. The sample sizes in the pump data are much too small to allow standard

goodness of fit tests, but residuals can be used, essentially as described in Section 5 of Atwood.[A-2]

Suppose n_+ nonlethal shocks hit the systems with m pumps and cause at least one pump to become inoperable. Then define

$$z_j = \binom{m}{j} p^j \, q^{m-j} / (1 - q^m)$$

for $1 \leq j \leq m$, with $q = 1 - p$. Let N_j be the number of shocks that affect exactly j pumps. Conditional on n_+, N_j has mean $E_j = n_+ \, z_j$ and variance $V_j = n_+ \, z_j \, (1 - z_j)$. Now suppose that there are systems with various sizes m_i, and corresponding values n_{+i}, N_{ji}, E_{ji}, and V_{ji}. Then, conditional on the values of n_{+i}, $N_{j\cdot} = \sum N_{ji}$ has mean $E_{j\cdot} = \sum E_{ji}$ and variance $V_{j\cdot} = \sum V_{ji}$. Here, the summations are over all i such that $m_i \geq j$. Substitution of the estimate of p gives $\hat{E}_{j\cdot}$ and $\hat{V}_{j\cdot}$. Then for each j, a standardized residual can be constructed

$$U_j = \frac{(N_{j\cdot} - \hat{E}_{j\cdot})}{\hat{V}_{j\cdot}^{1/2}} \, .$$

Under the BFR assumptions, the U_j values have a mean and variance of approximately 0 and 1. Any large value of U_j indicates that the data do not satisfy the BFR assumptions.

Effect of Data Inaccuracies

In the main body of this report, at the end of the Common Cause Classification section, there was a description of an actual experience suggesting the importance of data misclassification. Now let us investigate the effect of data inaccuracies more theoretically, by asking, "What effect does a small relative change in the data have on the estimates?" This effect can be approximated by the use of the relevant derivatives. Let θ denote a parameter to be estimated (λ, λ_+, ω, p, μ, β, or an r_k). Let x denote some quantity in the data (n_I, n_+, n_L, or v, all defined

below). Relative change means the change in the quantity, divided by the value of the quantity. Then the rate of relative change in the estimate of θ per relative change in x is

$$C(\theta, x) = \frac{\partial \hat{\theta}}{\partial x} \cdot \frac{x}{\hat{\theta}} \quad . \tag{A-1}$$

Approximate formulas will now be derived.

It is convenient during the derivation to work with maximum likelihood estimators rather than Bayes means. The difference between these two estimators is not important here, because the purpose is only to roughly approximate the effect of data inaccuracies. Suppose data are combined from systems with populations m_i and times t_i. Let n_{Ii}, n_{+i}, n_{Li}, and s_i denote the observed numbers of individual faults, nonlethal shocks, lethal shocks, and pumps made inoperable by nonlethal shocks. Then the maximum likelihood estimates satisfy

$$\hat{\lambda} = \frac{\sum n_{Ii}}{\sum m_i t_i}$$

$$\hat{\lambda}_+ = \frac{\sum n_{+i}}{\sum t_i}$$

$$\hat{\omega} = \frac{\sum n_{Li}}{\sum t_i}$$

$$\sum s_i = \hat{p} \sum \frac{m_i \, n_{+i}}{1 - \hat{q}^{m_i}} \quad . \tag{A-2}$$

Equation (A-2) requires knowledge of each separate $m_i n_{+i}$. However, it can be approximated by

$$\sum s_i \doteq \frac{\hat{p} \sum m_i n_{+i}}{(1 - \hat{q}^{\bar{m}})}$$

where m, generally not an integer, is the weighted average defined by

$$m = \frac{\sum m_i n_{+i}}{\sum n_{+i}}$$

where the sum is taken over all i such that $m_i > 1$. The terms with $m_i = 1$ are not counted because they contain no information about p.

So now, if we define $n_I = \sum n_{Ii}$, $n_+ = \sum n_{+i}$, $n_L = \sum n_{Li}$, and $v = \sum s_i / \sum m_i n_{+i}$, and if m is as just defined, then the estimates satisfy

$$\hat{\lambda} = \frac{n_I}{\sum m_i t_i}$$

$$\hat{\lambda}_+ = \frac{n_+}{\sum t_i}$$

$$\hat{\omega} = \frac{n_L}{\sum t_L}$$

$$\hat{p} \doteq v\,(1 - \hat{q}^m) \quad .$$

Finally, the coefficients $C(\theta, x)$ defined by Equation (A-1), can be approximated for $\theta = \lambda$, λ_+, ω, p, μ, r_k, or β, and for $x = n_I$, n_+, n_L, or v. Formulas are given in Table A-1, and very rough approximate values are given in Table A-2. For these approximations it is assumed that $r_1 \doteq \lambda$.

These coefficients are used as in the following example. Suppose that information is needed about the effect on the estimate r_1 of increasing n_I and v by 10% and decreasing n_+ by 5%. The relative change is

TABLE A-1. FORMULAS FOR $C(\theta, x) = \frac{\partial \hat{\theta}}{\partial x} \cdot \frac{x}{\hat{\theta}}$

	x			
θ	n_I	n_+	n_L	v
λ	1	0	0	0
λ_+	0	1	0	0
ω	0	0	1	0
P	0	0	0	$\frac{1 - q^m}{1 - q^m - m\,p\,q^{m-1}}$
μ	0	1	0	$1 - C(p,v)$
r_1	$\frac{\lambda}{r_1}$	$\frac{\mu p}{r_1}$	$\frac{\omega}{r_1}$	$\frac{\mu p}{r_1}$
r_k, $k > 1$	0	$\frac{\mu p^k}{r_k}$	$\frac{\omega}{r_k}$	$\frac{\mu p^k}{r_k}[1 + (k - 1)\,C(p,v)]$
β	$\frac{\lambda}{r_1}$	$\frac{D}{D + \omega}$	$\frac{\mu p}{r_1}$	$\frac{\omega}{D + \omega}$ $\frac{D + (m - 1)\mu p^2\, q^{m-2}\, C(p,v)}{D + \omega} - C(r_1,v)$

Notes:

1. Here, D denotes $\mu p(1 - q^{m-1})$.
2. For typographical clarity, the hat is omitted from estimated quantities.

TABLE A-2. CRUDE APPROXIMATIONS FOR $C(\theta, x)$[a]

	x			
θ	n_I	n_+	n_L	v
λ	1	0	0	0
λ_+	0	1	0	0
ω	0	0	1	0
p	0	0	0	>1
μ	0	1	0	<0
r_1	± 1	± 0	± 0	± 0
r_k, $k > 1$	0	<1	<1	varies
β	± -1	<1	<1	varies

a. This table shows, for example: If n_I increases by 10%, β will decrease by approximately 10%; if v increases by 5%, p will increase by more than 5%. For unusual data, the assumptions underlying the approximations may not be true. For very small data sets, small relative changes are impossible, so the table is irrelevant.

$$\frac{\Delta\hat{r}_1}{\hat{r}_1} \pm C(r_1,n_I) \times (0.1) + C(r_1, n_+) \times (-0.05) + C(r_1,v) \times (0.1)$$

Of course, the real difficulty is not in calculating derivatives, but in deciding how much inaccuracy might realistically be in the data. Inaccuracy due to misclassification of the reported events was addressed in the Common Cause Classification section of the main body of this report. To assess the amount of missing data (unreported events or overlooked reports) is beyond the scope of this report.

References

A-1. N. L. Johnson and S. Kotz, Discrete Distributions, New York: John Wiley & Sons, 1969, pp. 122-125.

A-2. C. L. Atwood, Estimators for the Binomial Failure Rate Common Cause Model, NUREG/CR-1401, EGG-EA-5112, April 1980.

APPENDIX B
PLANT INFORMATION AND CODE DEFINITIONS

APPENDIX B
PLANT INFORMATION AND CODE DEFINITIONS

Table B-1 summarizes the systems of pumps considered in this report, and gives their codes and relevant exposure hours. Tables B-2 and B-3 give plant information: for each plant, its code, critical hours, calendar hours, and pump populations are shown. Table B-4 defines the codes used in the one-line data summaries.

TABLE B-1. SYSTEMS OF PUMPS, AND RELEVANT EXPOSURE HOURS

Code	Hours	Reactor Type	Description[a]
Running Pumps			
K	Critical	Both	Reactor coolant/recirculation
Alternating Pumps			
G	Calendar	PWRs	Chemical and volume control (CVC)
H	Critical	BWRs	Feed and HPCI (4 plants only)
I	Critcal	PWRs	Boric acid transfer
J	Calendar	Both	Component cooling water
R	Shutdown	Both	Residual heat removal[b] (RHR)
Standby Pumps			
B	Critical	PWRs	Auxiliary feedwater
D	Calendar	BWRs	Low pressure core spray
F	Calendar	Both	Containment spray
H	Calendar	Both	High pressure coolant injection (HPCI)
L	Critical	Both	Low pressure cooling injection[b] (LPCI)
Q	Critical	BWRs	Reactor core isolation cooling (RCIC)
U	Critical	BWRs	Standby liquid control

a. Terminology varies somewhat from plant to plant.

b. At most plants, the same pumps serve for LPCI during criticality and for RHR during shutdown.

TABLE B-2. PWR PLANT INFORMATION[a]

Plant	Code	Vendor	Critical Hours	Calendar Hours	Running	Alternating				Standby			
					Reactor Clt K	CVC G	BAT I	CCW J	RHR[b] R	Auxiliary Feed[c] B	Containment Spray F	HPCI H	LPCI[b] L
Arkansas 1	AR1	B	33594	53952	4	3	2	3	2	1M, 1T	2	0[d]	2
Crystal River 3	CR3	B	17695	32544	4	3	2	3	2	1M, 1T	2	0[d]	2
Davis-Besse 1	DB1	B	13042	26808	4	2	2	3	2	2T	2	0[d]	2
Oconee 1	OE1	B	45079	65328	4	3	2	2	3	1T	2	0[d]	3
Oconee 2	OE2	B	37558	60384	4	3	3	2	3	1T	2	0[d]	3
Oconee 3	OE3	B	36816	53232	4	3	3	2	3	1T	2	0[d]	3
Rancho Seco	RS1	B	29290	52968	4	3	2	2	2	1M, 1T	2	0[d]	2
Three Mile Island 1	TI1	B	31732	42192	4	3	2	2	2	2M, 1T	2	0[d]	2
Three Mile Island 2	TI2	B	3398	8784	4	3	2	2	2	2M, 1T	2	0[d]	2
Arkansas 2	AR2	C	7068	15984	4	3	2	3	2	1M, 1T	2	3	2
Calvert Cliffs 1	CC1	C	38451	52464	4	3	2	3	2	2T	2	3	2
Calvert Cliffs 2	CC2	C	26811	33624	4	3	2	3	2	2T	2	3	2
Fort Calhoun	FC1	C	47570	62712	4	3	2	3	2	1M, 1T	3	3	2
Millstone 2	MI2	C	30580	43464	4	3	2	3	2	2M, 1T	2	3	2
Maine Yankee	MY1	C	55878	69600	3	1	3	2	2	1M, 1T	3	3	2
Palisades	PA1	C	38960	76704	4	3	2	3	2	1M, 1T	3	2	2
St. Lucie 1	SL1	C	26228	38952	4	3	2	3	2	2M, 1T	2	3	2
Beaver Valley	BV1	W	13775	38520	3	3	2	3	2	2M, 1T	6	2	2
D. C. Coole 1	DC1	W	37510	49992	4	3	2	3[e]	2	2M[f], 1T	2	2	2
D. C. Coole 2	DC2	W	16811	22464	4	3	2	3[e]	2	2M[f], 1T	2	2	2
Haddam Neck	HN1	W	63506	76704	4	3	2	3	2	2T	0[g]	2	2
Indian Point 2	IP2	W	37770	64536	4	3	2	3	2	2M, 1T	2	3	2
Indian Point 3	IP3	W	26443	39336	4	3	2	3	2	2M, 1T	2	3	2
J. M. Farley 1	JF1	W	16271	27576	3	3	2	3	2	2M, 1T	2	0[d]	2
Kewaunee	KE1	W	46125	57600	2	3	2	2	2	2M, 1T	2	2	2
North Anna 1	NA1	W	15859	21840	3	3	2	4	2	2M, 1T	6	0[d]	2
North Anna 2	NA2	W	1724	2664	3	3	2	4	2	2M, 1T	6	0[d]	2
Prairie Island 1	PR1	W	46464	59904	2	3	2	2	2	2M[f], 1T	2	3[h]	2
Prairie Island 2	PR2	W	44184	50760	2	3	2	2	2	2M[f], 1T	2	3[h]	2
Point Beach 1	PT1	W	62073	76704	2	3	2	2	2	2M[f], 1T	2	2	2
Point Beach 2	PT2	W	64363	73104	2	3	2	2	2	2M[f], 1T	2	2	2
R. E. Ginna	RG1	W	58078	76704	2	3	2	2	2	2M, 1T	2	3	2

TABLE B-2. (Continued)

Plant	Code	Vendor	Critical Hours	Calendar Hours	Running	Alternating				Standby			
					Reactor Clt K	CVC G	BAT I	CCW J	RHR[b] R	Auxiliary Feed[c] B	Containment Spray F	HPCI H	LPCI[b] L
H. B. Robinson 2	RO2	W	60180	76704	3	3	2	3	2	2M, 1T	2	3	2
Salem 1	SA1	W	16488	33360	4	3	2	3	2	2M, 1T	2	2	2
Sequoyah 1	SE1	W	542	2112	4	3	2	5	2	2M, 1T	2	2	2
San Onofre 1	SO1	W	56392	76704	3	2	2	3	2	1M, 1T	0	3	2
Surry 1	SU1	W	42519	72336	3	3[h]	2	4[h]	2[i]	2M, 1T	6[j]	3	2[i]
Surry 2	SU2	W	35584	66360	3	3[h]	2	4[h]	2[i]	2M, 1T	6[j]	3	2[i]
Trojan	TR1	W	21998	42048	4	3	2	3	2	1T, 1D	2	4	2
Turkey Point 3	TU3	W	52956	69672	3	3	3	2	2	3T[h]	2	4	2
Turkey Point 4	TU4	W	46080	64056	3	3	3	2	2	3T[h]	2	4	2
Yankee Rowe	YR1	W	53515	76704	4	3	1	2	2[i]	1T	0	3	3[i]
Zion 1	ZI1	W	42451	63864	4	3	2	5	2	2M, 1T	3[k]	2	2
Zion 2	ZI2	W	37666	59352	4	3	2	5	2	2M, 1T	3[k]	2	2

a. Pumps are motor-driven unless otherwise noted.

b. Unless otherwise noted, the same pumps are used for LPCI and RHR.

c. The letters M, T, and D denote motor-driven, turbine-driven, and diesel-driven. For example 2M, 1T means that 2 motor-driven pumps and 1 turbine-driven pump are present.

d. The HPCI and CVC pumps are shared. Population and faults are counted under CVC.

e. The two units have five pumps: two per unit and one shared by either unit.

f. A total of two motor-driven pumps is available for use by either unit.

g. Containment spray is an integral part of LPCI. Population and faults are counted under LPCI.

h. The two units share the same pumps.

i. There are separate pumps for LPCI and RHR.

j. Two of the pumps can be driven by either a motor or a turbine (tandem prime movers).

k. One pump is diesel-driven.

TABLE B-3. BWR PLANT INFORMATION[a]

Plant	Code	Vendor	Critical Hours	Calendar Hours	Running	Alternating		Standby					
					Coolant Recirculation K	CCW J	RHR[b] R	Core Spray D	Containment Spray[c] F	HPCI[d] H	LPCI[b] L	RCIC[d] Q	SLC U
Browns Ferry 1	BF1	G	32634	62448	2	3	4	4	0	1	4	1	2
Browns Ferry 2	BF2	G	29788	54360	2	3	4	4	0	1	4	1	2
Browns Ferry 3	BF3	G	26961	36360	2	3	4	4	0	1	4	1	2
Big Rock Point	BP1	G	51445	76704	2	2	2	2	2	0	0	0	0
Brunswick 1	BR1	G	22445	34896	2	3	4	2	0	1	4	1	2
Brunswick 2	BR2	G	27176	48528	2	3	4	2	0	1	4	1	2
Cooper Station	CO1	G	45502	57936	2	4	4	2	0	1	4	1	2
Duane Arnold	DA1	G	35182	57216	2	3	4	2	0	1	4	1	2
Dresden 1	DR1	G	39786	59904	4	3	2	3	2	1[e]	3	0	0
Dresden 2	DR2	G	58693	76704	2	3	3[f,g]	2	0	1	4[f]	0	2
Dresden 3	DR3	G	56458	76704	2	3	3[f,g]	2	0	1	4[f]	0	2
E. I. Hatch 1	EN1	G	39105	53064	2	3	4	2	0	1	4	1	0
E. I. Hatch 2	EN2	G	10147	19680	2	3	4	2	0	1	4	1	2
J. A. Fitzpatrick	FP1	G	30779	51480	2	3	4	2	0	1	4	1	2
Millstone 1	MI1	G	58150	76704	2	2	4	2	0	3[h]	4	0	2
Monticello	MO1	G	62706	76704	2	2	4	2	0	1	4	1	2
Nine Mile Point 1	NM1	G	58566	76704	5	3	3	8	4	2[h]	3	0	2
Oyster Creek	OC1	G	55263	76704	5	2	3	8	4	3[h]	3	0	2
Peach Bottom 2	PB2	G	40497	61728	2	2	4	4	0	1	4	1	2
Peach Bottom 3	PB3	G	40274	53928	2	2	4	4	0	1	4	1	2
Pilgrim 1	PI1	G	48238	72696	2	6	4	2	0	1	4	1	2
Quad-Cities 1	QC1	G	56398	76704	2	3[i]	4	2	0	1	4[j]	1	2
Quad-Cities 2	QC2	G	56912	73920	2	3[i]	4	2	0	1	4[j]	1	2
Vermont Yankee	VY1	G	57426	74712	2	3	4	2	0	1	4	1	2

a. Pumps are motor-driven unless otherwise noted.

b. Unless otherwise noted, the same pumps are used for LPCI and RHR.

c. At most plants, containment spray is an integral part of LPCI. A population 0 means that the population and faults are counted under LPCI.

d. HPCI and RCIC pumps are turbine-driven, except where indicated by notes.

e. The emergency feed pump is counted as HPCI. It is motor-driven, and considered an alternating pump for this report.

f. There are separate pumps for LPCI and RHR.

g. Units 2 and 3 have a total of five RHR pumps: two per unit and one shared between units.

h. The main feed pumps serve as HPCI pumps. They are motor-driven, and alternating rather than standby.

i. Units 1 and 2 have a total of five pumps: two per unit and one shared between units.

j. At each plant there are four motors, with each motor driving a gang of two pumps in series.

TABLE B-4. CODES USED IN ONE-LINE DESCRIPTIONS

FAILURE MODE

CODE	DESCRIPTION
A	LEAKAGE/RUPTURE
B	DOES NOT START
C	LOSS OF FUNCTION
D	DOES NOT CONTINUE TO RUN

COMPONENT

CODE	DESCRIPTION
PD	DIESEL-DRIVEN PUMP
PM	MOTOR-DRIVEN PUMP
PT	TURBINE-DRIVEN PUMP

TYPE OF EVENT

CODE		
FAILURE	COMMAND FAULT	DESCRIPTION
R	S	NONRECURRING, NOT COMMON CAUSE
C	T	RECURRING, NOT COMMON CAUSE
B	U	NONLETHAL COMMON CAUSE
L	V	RECURRING NONLETHAL COMMON CAUSE
M	N	LETHAL COMMON CAUSE
	O	RECURRING LETHAL COMMON CAUSE

FAILURE CAUSE

CODE	DESCRIPTION
00	UNKNOWN
01	PERSONNEL (OPERATIONS)
02	PERSONNEL (MAINTENANCE)
03	PERSONNEL (TESTING)
04	DESIGN ERROR
05	FAB./CONSTRUCTION/Q.C.
06	PROCEDURAL DISCREPANCIES
07	NORMAL WEAR
08	EXCESSIVE WEAR
09	FOREIGN MATERIAL CONTAMINATION
10	CORROSION/EROSION
11	EXTREME ENVIRONMENT
12	LOOSE FASTENER
13	ELECTRICAL/MECHANICAL CONTROL MALFUNCTIONS
14	FAILED INTERNALS
15	SHAFT/COUPLING FAILURE
16	LOSS OF PRESSURE BOUNDRY INTEGRETY
17	IMPROPER CLEARANCES
18	DRIVE TRAIN FAILURE
19	SEAL/PACKING FAILURE
20	MISALIGNMENTS
21	BEARING FAILURE

NSSS VENDOR

CODE	DESCRIPTION
B	BABCOCK & WILCOX
C	COMBUSTION ENGINEERING
G	GENERAL ELECTRIC
W	WESTINGHOUSE

EVENT CLASSIFICATION

CODE	DESCRIPTION
D	DEMAND
T	TIME
U	UNKNOWN

ACTIVITY RESULTING IN DISCOVERY

CODE	DESCRIPTION
M	DURING MAINTENANCE
N	DURING NORMAL OPERATIONS
R	DURING RECORDS REVIEW
T	DURING TESTING
U	UNKNOWN

APPENDIX C
ESTIMATED FAULT RATES

APPENDIX C
ESTIMATED FAULT RATES

This appendix contains six sections, corresponding to the six groups of pumps for which rates are estimated. The six groups, listed in Table 2 of the main body of this report, are

1. Running pumps

2. Alternating pumps

3. PWR auxiliary feedwater pumps

4. BWR turbine-driven HPCI and RCIC pumps

5. Other standby pumps

6. PWR HPCI and CVC pumps (treated as one system).

Each section contains some introductory remarks. Then, the estimated rates are presented (except for running pumps) for four sets of rates: failure to start, based on all faults; failure to start, based on failures only; failure to operate after starting, based on all faults; and failure to operate after starting, based on failures only. For running pumps, only rates of failure to start are estimated. Following the estimated rates are summaries of the data used: one summary for each of the two failure modes; and a listing of the one-line summaries of the relevant LERs.

Running Pumps

The pumps considered are PWR reactor coolant pumps and BWR coolant recirculation pumps. The exposure times used are critical hours.

In all the data, there is only one reported failure to start. Therefore, rates are not estimated for failure to start, but only for failure to operate after starting.

All the nonlethal shocks were command faults rather than failures. Therefore, the quantities involving p cannot be estimated for failures.

There were eight lethal shocks, more than for any other system. They occurred at only five plants. This recurrence at certain plants leads to a very wide interval estimate for ω, with the lower bound essentially zero. Of the eight lethal shocks, three were loss of power, and one was failure of the containment instrument air system. In many fault tree analyses, such hardware failures would be built into the fault tree explicitly, and so should not be counted a second time in the rates from this report. For possible use in such analyses, the rates are estimated excluding lethal shocks due to hardware failure.

In summary, rates are estimated for failure to operate after starting:

1. Based on all faults

2. Based on failures only

3. Based on all faults, excluding lethal shocks due to hardware failure

4. Based on failures only, excluding lethal shocks due to hardware failure.

Be sure to read the Application section in the main body of this report. The following printouts give the estimates and summaries of the relevant data.

RUNNING PUMPS - REACTOR COOLANT / RECIRCULATION
FAILURE TO OPERATE, GIVEN START
ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS
RATES ARE PER CRITICAL HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.371, .608, .816)
LAMBDA = (1.7E-09, 1.3E-05, 5.8E-05)
LAMBDA+ = (7.5E-13, 2.0E-06, 1.0E-05)
OMEGA = (5.8E-34, 5.8E-06, 3.0E-05)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
2	(9.1E-13, 2.4E-06, 1.3E-05)	(1.8E-07, 2.0E-05, 9.5E-05)	(.000, .024, .850)
3	(8.2E-13, 2.2E-06, 1.1E-05)	(1.8E-07, 2.0E-05, 9.4E-05)	(.000, .016, .800)
4	(7.8E-13, 2.1E-06, 1.1E-05)	(1.8E-07, 2.0E-05, 9.4E-05)	(.000, .008, .753)
5	(7.6E-13, 2.0E-06, 1.1E-05)	(1.8E-07, 2.0E-05, 9.4E-05)	(.000, .004, .724)
OVERALL	(7.6E-13, 2.0E-06, 1.3E-05)	(1.8E-07, 2.0E-05, 9.5E-05)	(.000, .016, .850)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4	R5
2	(3.1E-13, 6.7E-06, 3.7E-05)			
3	(2.8E-13, 6.6E-06, 3.7E-05)	(1.6E-13, 6.4E-06, 3.4E-05)		
4	(2.7E-13, 6.6E-06, 3.7E-05)	(1.5E-13, 6.3E-06, 3.4E-05)	(8.7E-14, 6.2E-06, 3.3E-05)	
5	(2.6E-13, 6.6E-06, 3.7E-05)	(1.5E-13, 6.3E-06, 3.4E-05)	(8.5E-14, 6.2E-06, 3.3E-05)	(4.8E-14, 6.1E-06, 3.2E-05)
OVERALL	(2.6E-13, 6.6E-06, 3.7E-05)	(1.5E-13, 6.3E-06, 3.4E-05)	(8.5E-14, 6.2E-06, 3.3E-05)	(4.8E-14, 6.1E-06, 3.2E-05)

RUNNING PUMPS - REACTOR COOLANT / RECIRCULATION
FAILURE TO OPERATE, GIVEN START
FAILURES ONLY, EXCLUDING COMMAND FAULTS
RATES ARE PER CRITICAL HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (1.0E-08, 5.2E-06, 2.1E-05)
$LAMBDA_+$ = (5.3E-10, 1.3E-07, 5.2E-07)
OMEGA = (4.7E-08, 4.0E-07, 1.1E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

RUNNING PUMPS - REACTOR COOLANT / RECIRCULATION
FAILURE TO OPERATE, GIVEN START
LETHAL SHOCKS DUE TO HARDWARE FAILURE EXCLUDED
ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS
RATES ARE PER CRITICAL HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.371, .608, .816)
LAMBDA = (1.7E-09, 1.3E-05, 5.8E-05)
LAMBDA$_t$ = (7.5E-13, 2.0E-06, 1.0E-05)
OMEGA = (4.2E-44, 2.7E-06, 1.2E-05)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
2	(9.1E-13, 2.4E-06, 1.3E-05)	(1.8E-07, 1.7E-05, 7.8E-05)	(.000, .024, .755)
3	(8.2E-13, 2.2E-06, 1.1E-05)	(1.8E-07, 1.7E-05, 7.8E-05)	(.000, .016, .654)
4	(7.8E-13, 2.1E-06, 1.1E-05)	(1.8E-07, 1.7E-05, 7.8E-05)	(.000, .008, .583)
5	(7.6E-13, 2.0E-06, 1.1E-05)	(1.8E-07, 1.7E-05, 7.8E-05)	(.000, .004, .533)
OVERALL	(7.6E-13, 2.2E-06, 1.3E-05)	(1.8E-07, 1.7E-05, 7.8E-05)	(.000, .016, .755)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4	R5
2	(3.1E-13, 3.6E-06, 2.0E-05)			
3	(2.9E-13, 3.5E-06, 1.9E-05)	(1.6E-13, 3.3E-06, 1.7E-05)		
4	(2.7E-13, 3.5E-06, 1.9E-05)	(1.5E-13, 3.2E-06, 1.7E-05)	(8.7E-14, 3.1E-06, 1.5E-05)	
5	(2.6E-13, 3.5E-06, 1.9E-05)	(1.5E-13, 3.2E-06, 1.7E-05)	(8.5E-14, 3.1E-06, 1.5E-05)	(4.8E-14, 3.0E-06, 1.4E-05)
OVERALL	(2.6E-13, 3.5E-06, 2.0E-05)	(1.5E-13, 3.2E-06, 1.7E-05)	(8.5E-14, 3.1E-06, 1.5E-05)	(4.8E-14, 3.0E-06, 1.4E-05)

RUNNING PUMPS - REACTOR COOLANT / RECIRCULATION
FAILURE TO OPERATE, GIVEN START
LETHAL SHOCKS DUE TO HARDWARE FAILURE EXCLUDED
FAILURES ONLY, EXCLUDING COMMAND FAULTS
RATES ARE PER CRITICAL HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

λ = (1.0E-08, 5.2E-06, 2.1E-05)
λ^{+} = (5.3E-10, 1.3E-07, 5.2E-07)
ω^{+} = (5.3E-10, 1.3E-07, 5.2E-07)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

ALL FAILURES TO OPERATE, GIVEN START, IN REACTOR COOLANT / RECIRCULATION PUMPS

PLANT	CRIT. HOURS	CALEND. HOURS	POP	NUMBER OF INDIV. FAULTS FAILRS/COM FLTS	NUMBER OF NONLETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY NONLETHAL SHOCKS FAILRS/COM FLTS	NUMBER OF LETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY LETHAL SHOCKS FAILRS/COM FLTS
AR1	33594	53952	4	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CR3	17695	32544	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DB1	13042	26808	4	2 / 2	0 / 0	0 / 0	0 / 2	0 / 8
DE1	45079	65328	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE2	37558	60384	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE3	36816	53232	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RS1	29290	52968	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI1	31732	42192	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI2	3398	8784	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AR2	7068	15984	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	38451	52464	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC2	26811	33624	4	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FC1	47570	62712	4	4 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI2	30580	43464	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MY1	55878	69600	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PA1	38960	76704	4	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
SL1	26228	38952	4	0 / 0	0 / 0	0 / 0	1 / 1	4 / 4
BV1	13775	38520	3	0 / 0	0 / 0	0 / 0	0 / 2	0 / 6
DC1	37510	49992	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC2	16811	22464	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	63506	76704	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	37770	64536	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP3	26443	39336	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	16271	27576	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KE1	46125	57600	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA1	15859	21840	3	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA2	1724	2664	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	46464	59904	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	44184	50760	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT1	62073	76704	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	64363	73104	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	58078	76704	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

RD2	60180	76704	3	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SA1	16488	33360	4	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
SE1	542	2112	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	56392	76704	3	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	42519	72336	3	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	35584	66360	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TR1	21998	42048	4	0 / 0	0 / 0	0 / 0	0 / 1	0 / 4
TU3	52966	69672	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU4	46080	64056	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
YR1	53515	76704	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	42451	63864	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	37666	59352	4	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0
BF1	32634	62448	2	0 / 0	0 / 2	0 / 4	0 / 0	0 / 0
BF2	29788	54360	2	0 / 4	0 / 0	0 / 0	0 / 0	0 / 0
BF3	26961	36360	2	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
BP1	51445	76704	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR1	22445	34896	2	0 / 4	0 / 0	0 / 0	0 / 0	0 / 0
BR2	27176	48528	2	5 / 7	0 / 0	0 / 0	0 / 1	0 / 2
CD1	45502	57936	2	2 / 2	0 / 0	0 / 0	0 / 0	0 / 0
DA1	35182	57216	2	2 / 2	0 / 0	0 / 0	0 / 0	0 / 0
DR1	39786	59904	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	58693	76704	2	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR3	56458	76704	2	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
EN1	37105	53064	2	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
EN2	10147	19680	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FP1	30779	51480	2	0 / 5	0 / 0	0 / 0	0 / 0	0 / 0
MI1	58150	76704	2	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MO1	62706	76704	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NM1	58566	76704	5	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
OC1	55263	76704	5	0 / 1	0 / 1	0 / 3	0 / 0	0 / 0
PB2	40497	61728	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB3	40274	53928	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PI1	48238	72696	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC1	56398	76704	2	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
QC2	56912	73920	2	0 / 3	0 / 0	0 / 0	0 / 0	0 / 0
VY1	57426	74712	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	2577618	3567552	209	36 / 35	0 / 5	0 / 10	1 / 7	4 / 24

ALL FAULTS IN REACTOR COOLANT / RECIRCULATION PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
B	AR1	015609	081676	K	PM	A19	R		1	N	D	"D" RCP SEAL FAILED CREATING 25 GPM RCS LEAK	CAUSE OF SEAL FAILURE UNKN,OTHR FAILRS OC
B	AR1	020529	120377	K	PM	A19	R		1	N	T	"C" RCP OUTER SEAL FAILED CREATING 5-6 GPM LEAK	ASSUMED NATURAL END-OF-LIFE SEAL FAILURE
B	AR1	031027	051080	K	PM	A19	R		1	N	U	RCP "C" SEAL FAILED	REPLACED SEAL
B	DB1	019712*	112977	K	PM	D13	O		4	N	D	ALL 4 RCP'S TRIPPD DUE TO LOSS OF 13.8 KV POWER	REACTOR/TURBINE TRIP OCCURED AT 2243 HOUR
B	DR1	025139	011579	K	PM	B01	U		1	N	D	RCP 1-2-2 STARTED WITH INCORRECT BKR ALIGNMENT	PERSONNEL ERROR
B	DR1	025526	022879	K	PM	D02	S		1	N	D	RCP 1-1-2 TRIPPED,DUE TO LOW COMP COOL H2O FLOW	PERSONNEL MAINTENANCE LOOSENED WRONG CCVE
B	DB1	027335*	101579	K	PM	D13	O		4	N	U	LOSS OF OFFSITE POWER CAUSED LOSS OF ALL 4 RCPS	LOSS OF OFFSITE POWER-OUTPUT BRKR FAULT
B	DR1	027421	102379	K	PM	D11			1	N	D	RCP 1-1-1 SECURED DUE TO BAD SEALS	THERMAL SHOCK
B	DR1	027422	102579	K	PM	D13	S		1	N	D	RCP 2-2 TRIPPED	BLOWN FUSE IN INTERLOCK CONTROL CIRCUIT
B	DR1	027867	112679	K	PM	D00			1	N	U	RCP 1-2 TRIPPED DUE TO LOW OIL LEVEL ALARM	NO CAUSE GIVEN
B	DE2	000688	012274	K	PM	D19			1	N	U	REAC COOLNT PMP RCP2B2 FAILD CAUSE NOT YET DETRMND	DISASMBLY SHOWD 1 CAPSCREW ,SPIROL MISSNG
C	CC1	013277	081075	K	PM	A19			1	N	U	11B RX COOLANT PUMP DEVELOPED 2.7 GPM LEAK	BOTH UPPER AND MIDDLE MECH SEALS FAILED
C	CC2	021059	070478	K	PM	A16	R		1	N	T	CRACKED WELD DISCOVERED ON 21B REACTOR COOLANT PUM	CAUSE OF WELD CRACK IS UNKNOWN
C	CC2	021844	071478	K	PM	D02	R		1	N	D	RCP SEAL COOLING HEAT EXCHANGER WELD FAILED	PREVIOUS WELD REPAIR WAS INADEQUATE
C	FC1	013525	092075	K	PM	A00			1	N	U	REACTOR COOLANT PUMP VAPOR SEALS LEAKED	CAUSE NOT GIVEN
C	FC1	031635*	051680	K	PM	A16			3	T	T	RCP'S 3A,B,&C FOUND LEAKING BETWEEN CASING & COVER	CORROSION TO STUDS & DETERIORATED GASKETS
C	PA1	025614	020179	K	PM	D00	S		1	N	U	PRIMARY COOLANT PUMP INADVERTANTLY STOPPED	CAUSE NOT GIVEN
C	SL1	017833*	041577	K	PM	D13	L		4	N	D	LOSS OF SEAL CLNG WTR TO RCPS - RCPS WERE SECURED	CONTAINMENT INST AIR SYSTEM FAILED
C	SL1	017935*	051677	K	PM	D13	N		4	N	D	LOST ALL FOUR REACTOR COOLANT PUMPS	LOSS OF OFF-SITE POWER
W	BV1	018241*	071977	K	PM	D04	N		3	T	D	LOAD REJECT. TEST FROM 50% PWR;PMPS TPIPPD UNDRFRQ	TURBINE CONTROL DESGN CONCEPTS
W	BV1	026984*	081979	K	PM	D01	N		3	N	D	ALL THREE RCPS TRIPPED ON UNDERFREQUENCY	OPERATOR ERROR
W	HN1	018911	082177	K	PM	A19			1	N	U	#2 RCP INDICATED SEAL FAILURE - SHUT DOWN	VIS INSP CONFMD SL FAILD - MOD# SU-4M-A1
W	IP2	018331	070277	K	PM	A19			1	N	U	NO. 23 RX COOLANT PUMP TRIPPED OFF-LINE MANUALLY	SEAL PACKAGE FAILED, TOT LKG 90,000 GAL
W	NA1	021636	053078	K	PM	D07			1	N	T	RCP C REQUIRED TO BE SECURED	LEAK IN LOWER LUBE OIL COOLER
W	RO2	012680	050175	K	PM	A19			1	N	U	REACTOR COOLANT PUMP LOST BOTH SHAFT SEALS	SEAL FAILURE - PUMP MODEL V11001-B1

ALL FAULTS IN REACTOR COOLANT / RECIRCULATION PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	SA1	022871*	102178	K	PM	A06			1		N	D	ALL THREE RCP SEALS FAILED	POSSIBLY TOO HIGH A DIFFERENTIAL PRESSURE
W	SA1	028073	122779	K	PM	D13	S		1		N	D	#12 RC PUMP TRIPPED	IF 4KV GROUP BUS WAS LOST
W	SD1	030015	011680	K	PM	D16			1		N	U	FIRE STARTED ON RCP 'A' FROM AN OIL LEAK	NO CAUSE GIVEN FOR OIL LIFT PUMP OIL LEAK
W	SU1	010417	113073	K	PM	D05			1		N	D	RCP 1A SHAFT FAILD AT 42% POWER	FILLET GROOVE ON SHFT INCORRECTLY MADE
W	SU1	027758	121979	K	PM	D18			1		N	T	1A REACTOR COOLANT PUMP TRIPPED	GROUND FAULT IN PUMP MOTOR
W	TP1	018991*	082177	K	PM	D01	N		4		N	D	POWER TO RCPS INADVERTENTLY DEENERGIZED	GEN OUTPUT BRKR WAS TRIPPED PREMATURELY
W	ZI2	016051*	091976	K	PM	D01	U		2		N	D	TWO RCPS WERE INADVERTENTLY TRIPPED OFF-LINE	PERSONNEL MADE SWITCHING ERROR
G	BF1	027159*	092679	K	PM	D03	V		2		N	D	A AND B RECIRCULATION PUMPS TRIPPED	TROUBLESHOOTING WRONG TERMINAL STOP
G	BF1	027682*	112679	K	PM	D03	V		2		N	D	BOTH RECIRC MG SETS SHUTDOWN DURING NORMAL OP.	PERSONNEL TESTING WRONG RELAYS
G	BF2	030311	020380	K	PM	D03	T		1		T	D	2A REACTOR RECIRC PUMP ACCIDENTLY TRIPPED	MISINTERPRETED PUMP LABEL ON TRIP BREAKER
G	BF2	030312	020380	K	PM	D13	S		1		N	D	2B RECIRC PUMP TRIPPED	SPURIOUS SIGNAL, MG SET GEN STATOR TEMP
G	BF2	030360	020680	K	PM	D03	T		1		N	D	2B RECIRC PUMP TRIPPED	WRONG RELAY OPERATED
G	BF2	031547	060780	K	PM	D11	T		1		N	T	2A RECIRC PUMP TRIPPED ON HIGH STATOR TEMP ON MG	LOOSE CONNECTION DUE TO VIBRATION
G	BF3	016268	103076	K	PM	D06	S		1		N	T	3B RECIRC TRIPPD DUE TO BURND COLLECTR RING ON MG	CARBON BRUSH WORE TOO SHORT
G	BF3	032542	090180	K	PM	D00			1		N	U	'A' RECIRC PUMP TRIPPED	CAUSE UNKNOWN
G	BR1	019493	102577	K	PM	D13	S		1		N	D	1A RECIRC TRIPPD DUE TO RECIRC MG SET TRIPPING	LO LUBE OIL PRESS. DUE TO CONTROL VALVE
G	BR1	020209	122977	K	PM	D02	S		1		N	D	RECIRC PMP 1A TRIPPD DUE TO MG SET TRIPPING	STRING ON MG BKR GOT CAUGHT AND TRIPPED
G	BR1	025091	010479	K	PM	D20	S		1		N	T	1A RECIRC PUMP TRIPPED DUE TO LOW LUBE OIL ON MG	MISSING LOCK NUT ON LO ADJ CAUSED DRIFT
G	BR1	031149	050180	K	PM	D13	S		1		N	T	1A RECIRC PUMP TRIPPED ON MG SET LOW LUBE OIL PRES	PRESS SW SET TOO HI WITH ERRATIC PRESSURE
G	BR2	013619	080475	K	PM	A04	R		1		N	D	AFTER SCRAM FROM PWR, 2B RX RECIRC PUMP LEAKED	HOT COOLANT REACHED SEALS, CRACKED SL FACE
G	BR2	013560	082475	K	PM	A04	R		1		N	D	AFTER SCRAM FROM PWR, 2B RX RECIRC PUMP LEAKED	HOT COOLANT REACHED SEALS, CRACKED SL FACE
G	BR2	013620	090575	K	PM	A04	R		1		N	D	AFTER SCRAM FROM PWR, 2B RX RECIRC PUMP LEAKED	HOT COOLANT REACHED SEALS, CRACKED SL FACE
G	BR2	013798	111475	K	PM	D13	S		1		N	U	56% PWR R/X RECIRC 2A TRIPPD--2A MG SET INOPERBLE	NO PROBLEM FOUND WITH MG SET
G	BR2	014947*	052776	K	PM	D01	N		2		T	D	RECIRC PUMPS TRIPPD ON LOW L.O. PRESS	OPERATOR DID NOT FOLLOW EMERGNCY PROCEDRE
G	BR2	014947A	052776	K	PM	D19	R		1		N	D	2B RECIRC SEALS FAILD FOLLOWING RX SCRAM 30% PWR	NOT STATED AS TO REASON

ALL FAULTS IN REACTOR COOLANT / RECIRCULATION PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	BR2	014946	053076	K	PM	D13	S	1	N	T		RECIRC LOOP INOP. DUE TO 2A MG SET TRIP ON OVERCRN	OVERCURRENT RELAY "50B" FAULTY
G	BR2	016397	110976	K	PM	A04	R	1	N	D		RX IN RUN MODE, ALARMS INDICATE 2B RECIRC PMP PROB	PUMP SEALS FAILED DUE TO THERMAL SHOCK
G	BR2	027769A	120679	K	PM	D13	T	1	N	D		2B RECIRC PUMP TRIPPED	BLOWN FUSES DUE TO SHORT BRUSHES
G	BR2	027769B	121379	K	PM	D13	T	1	N	D		2B RECIRC PUMP TRIPPED	BLOWN FUSES DUE TO SHORT BRUSHES
G	BR2	030194A	012390	K	PM	D13	T	1	N	D		2B RECIRCULATION PUMP TRIPPED	FUSES BLOWN IN VOLT FEEDBACK CIRCUITRY
G	BR2	030194B	021080	K	PM	D13	T	1	N	D		2B RECIRCULATION PUMP TRIPPED	FUSES BLOWN IN VOLT FEEDBACK CIRCUITRY
G	BR2	030526	022980	K	PM	D06	S	1	T	D		2A REACTOR RECIRC PUMP TRIPPED	WIRE CONNECTED FOR TEST, CAUSED TRIP
G	CO1	014302	020676	K	PM	D00		1	N	U		RECIRC PMP "B" TRIPPD	UNKNOWN
G	CO1	014360	022776	K	PM	D04	S	1	N	T		RR PUMP "B" DRIVE MOTOR TRIPPD TWICE --TEMP.SWITCH	SWITCH TRIPPD DUE TO VIBRATION;TYPE DA438
G	CO1	016604	111276	K	PM	D13	S	1	N	T		"B" RECIRC PMP TRIPPD DUE TO FALSE OP.OF N8I-LIS	MOISTURE IN MODEL 4418C SWITCH;LEAKY VLVE
G	CO1	027345	091279	K	PM	A19		1	N	T		LEAK DEVELOPED FROM 'B' RECIRC SEAL	SEAL REPLACED
G	DA1	010580	081474	K	PM	A19		1	U	T		UNIDENTIFIED LKG TO DRYWELL EXCEEDED TS LMT, 5 GPM	LKG FRM RECIRC PMP B SEALS, CORRSN PRDCTS
G	DA1	019705	102877	K	PM	C13	S	1	N	T		"A" RECIRC HAD SLIGHT DECREAS IN FLOW DUE TO M-G	VOLT. REG. FOR MG HAD OPEN IN TRANSFORMR
G	DA1	031167	043080	K	PM	D18		1	N	T		'A' RECIRC PUMP MG SET TRIPPED ON UNDER VOLTAGE	SHORT IN PUMP MOTOR
G	DA1	031422	052880	K	PM	D00	S	1	N	U		'B' RECIRC PUMP SECURED DUE TO HI/LOW LO ALARM	NO CAUSE FOUND FOR LOSS OF LUBE OIL LEVEL
G	DR2	010808	101874	K	PM	A19		1	N	T		"B"RECIRCULATION PUMP SEALS LEAKING	LEAKING MECHANICAL SEAL
G	DR3	018549	080477	K	PM	C03	U	1	T	D		"A" RECIRC PUMP DID NOT RUNBACK DURIN FEED SYS TST	OPERATOR TURND OFF CONT.PWR TO "A" RECIRC
G	EN1	030243	012780	K	PM	D13	S	1	N	T		'A' RECIRC PUMP TRIPPED WHILE AT POWER	GROUND IN CONTROL CIRCUIT
G	FP1	014486	040376	K	PM	D04	S	1	N	D		RECIRC PMP "A" TRIPPD DUE TO EXCITER OVERCURRENT	WATER LEAKAGE INTO CONTROL CABINET
G	FP1	015236	063076	K	PM	D00	S	1	N	U		LOSS OF "B" RECIRC PUMP LOSS OF POWER DURIN TRANSF	BUS 10200 FAILD TO TRANSFER TO RECER. PWR
G	FP1	017329	022877	K	PM	D15	S	1	N	T		RECIRC PUMP MG SET TRIPPED ON LOW OIL PRESSURE	FAILURE OF THE DRIVE TO THE OIL PUMP
G	FP1	017338	030777	K	PM	C13	S	1	N	T		B RECIRC PUMP CONTROL RKT PROBLEM CAUSED SPEED MIS	RECIRC PUMP CONTROL CKT PROBLEM CAUSED SP
G	FP1	019296	100577	K	PM	D03	S	1	T	D		B RECIRC MG SET INADVERTNTLY TRIPPD,LOST "B" PUMP	OPERATOR ERROR DURING TEST
G	MI1	002363	082972	K	PM	A19		1	N	U		PRIMARY LEAK OF 5.61GPM TECH SPEC-5GPM	RECIRCULATION PUMP "A" SEALS LEAKING
G	NM1	002129	091972	K	PM	A19	R	1	N	T		RECIRC PUMP SEAL LEAKED EXCESSIVELY	NO CAUSE GIVEN - OTHER THAN LEAKY SEAL

ALL FAULTS IN REACTOR COOLANT / RECIRCULATION PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	NM1	000455	101873	K	PM	A19	R	1	N	T			RX RECIRC PUMP 12 HAD SMALL SEAL LEAK	NO CAUSE GIVEN - OTHER THAN LEAKY SEAL
G	NM1	019586	110677	K	PM	A19	R	1	N	U			LEAK GT. 5GPM FORCD POWR REDCTN #12 RC PUMP	SEAL FAILD RPLCD SEALS ON #11,#14 PMP ALS
G	QC1	013630*	121275	K	PM	D03	U	3	T	D			DEENERG 125V DC DIST CTR - LOSS OF 3 RECIRC PUMPS	PERSONNEL DID NOT FOLLOW PROCEDURES
G	QC1	025518	032279	K	PM	D13	S	1	N	T			'C' RECIRC PUMP KEPT TRIPPING	LOSS OF GENERATOR FIELD,FAILED POTENIOMET
G	QC1	031190	042980	K	PM	D13	S	1	N	D			1A RECIRC PUMP TRIPPED WHEN MG LUBE OIL PUMP TRIP	CAUSE UNKNOWN WHY LUBE OIL PUMP TRIPPED
G	QC2	019540	101377	K	PM	D13	T	1	N	T			2A RECIRC PUMP M/G FAILED - LOST 2A RECIRC PUMP	LOOSE TACH COUPLING - GENERATOR VIBRATION
G	QC2	025430	022379	K	PM	D13	T	1	N	T			2A RECIRC PUMP TRIPPED	MG SET TACHOMETER COUPLING FAILD
G	QC2	032646	082980	K	PM	D13	S	1	N	T			'A' RECIRCULATION PUMP MG FIELD BKR OPENED	FAILED CONTROL POWER TRANSFORMER

Alternating Pumps

The pumps considered are: PWR chemical and volume control pumps; BWR feed pumps that serve for HPCI (at four plants only); PWR boric acid transfer pumps; component cooling water pumps; and residual heat removal pumps. The exposure hours used for the different systems are listed in Table B-1.

The nonlethal common cause failures to operate after starting tend to cluster at a relatively small number of plants. This leads to a very wide interval for λ_+.

Rates are estimated for:

1. Failure to start, based on all faults

2. Failure to start, based on failures only

3. Failure to operate after starting, based on all faults

4. Failure to operate after starting, based on failure only.

Be sure to read the Application section in the main body of this report. The following computer printouts give the estimates and summaries of the relevant data.

ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BAT, BWR MOTOR-OR HPCI
FAILURE TO START
ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS
RATES ARE PER EXPOSURE HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.109, .278, .473)
LAMBDA = (7.0E-10, 2.3E-06, 1.0E-05)
LAMBDA = (3.0E-12, 1.3E-06, 6.9E-06)
OMEGA = (2.2E-10, 5.7E-08, 2.2E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(1.2E-11, 6.0E-06, 2.9E-05)	(2.8E-08, 3.7E-06, 1.4E-05)	
2	(6.7E-12, 3.4E-06, 1.7E-05)	(2.5E-08, 3.1E-06, 1.2E-05)	(.000, .089, .394)
3	(5.2E-12, 2.6E-06, 1.3E-05)	(2.4E-08, 2.9E-06, 1.1E-05)	(.000, .097, .476)
4	(4.4E-12, 2.1E-06, 1.1E-05)	(2.4E-08, 2.8E-06, 1.1E-05)	(.000, .096, .459)
5	(4.0E-12, 1.9E-06, 9.6E-06)	(2.4E-08, 2.8E-06, 1.1E-05)	(.000, .093, .444)
6	(3.8E-12, 1.8E-06, 8.9E-06)	(2.4E-08, 2.8E-06, 1.1E-05)	(.000, .088, .432)
OVERALL	(3.8E-12, 2.6E-06, 2.9E-05)	(2.4E-08, 2.9E-06, 1.4E-05)	(.000, .093, .476)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(7.8E-11, 2.8E-07, 1.2E-06)		
3	(1.3E-10, 2.3E-07, 1.0E-06)	(7.2E-10, 1.2E-07, 4.3E-07)	
4	(1.8E-10, 2.1E-07, 9.0E-07)	(7.6E-10, 1.1E-07, 4.0E-07)	(6.4E-10, 7.7E-09, 2.8E-07)
5	(2.2E-10, 2.0E-07, 8.4E-07)	(7.7E-10, 1.1E-07, 3.9E-07)	(6.2E-10, 7.5E-09, 2.7E-07)
6	(2.5E-10, 1.9E-07, 8.0E-07)	(7.6E-10, 1.0E-07, 3.8E-07)	(6.0E-10, 7.5E-09, 2.7E-07)
OVERALL	(7.8E-11, 2.1E-07, 1.2E-06)	(7.2E-10, 1.1E-07, 4.3E-07)	(6.0E-10, 7.5E-09, 2.8E-07)

ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BAT, BWR MOTOR-DR HPCI
FAILURE TO START
FAILURES ONLY, EXCLUDING COMMAND FAULTS
RATES ARE PER EXPOSURE HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.002, .146, .459)
LAMBDA = (1.1E-07, 5.6E-07, 1.3E-06)
$LAMBDA_+$ = (1.2E-07, 4.0E-07, 8.0E-07)
OMEGA = (2.2E-10, 5.7E-08, 2.2E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(5.5E-07, 3.5E-04, 1.9E-04)	(4.2E-07, 1.0E-06, 1.8E-06)	
2	(3.4E-07, 1.8E-04, 9.8E-05)	(3.1E-07, 8.3E-07, 1.6E-06)	(.003, .079, .293)
3	(2.7E-07, 1.2E-04, 6.5E-05)	(2.7E-07, 7.7E-07, 1.5E-06)	(.006, .094, .340)
4	(2.4E-07, 8.9E-05, 4.9E-05)	(2.5E-07, 7.4E-07, 1.5E-06)	(.004, .097, .356)
5	(2.2E-07, 7.1E-05, 3.9E-05)	(2.3E-07, 7.2E-07, 1.5E-06)	(.004, .094, .365)
6	(2.0E-07, 5.9E-05, 3.3E-05)	(2.2E-07, 7.1E-07, 1.5E-06)	(.004, .090, .369)
OVERALL	(2.6E-07, 1.2E-04, 1.9E-04)	(2.2E-07, 7.7E-07, 1.8E-06)	(.003, .094, .369)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(1.8E-09, 9.1E-08, 2.8E-07)		
3	(1.3E-09, 8.4E-08, 2.6E-07)	(4.3E-10, 6.6E-08, 2.3E-07)	
4	(1.1E-09, 8.0E-08, 2.6E-07)	(4.2E-10, 6.5E-08, 2.3E-07)	(3.0E-10, 6.0E-08, 2.2E-07)
5	(9.9E-10, 7.8E-08, 2.6E-07)	(4.1E-10, 6.4E-08, 2.3E-07)	(3.0E-10, 6.0E-08, 2.2E-07)
6	(9.1E-10, 7.7E-08, 2.6E-07)	(4.0E-10, 6.4E-08, 2.3E-07)	(3.0E-10, 6.0E-08, 2.2E-07)
OVERALL	(9.1E-10, 8.0E-08, 2.8E-07)	(4.0E-10, 6.5E-08, 2.3E-07)	(3.0E-10, 6.0E-08, 2.2E-07)

ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BAT, BWR MOTOR-DR HPCI
FAILURE TO OPERATE, GIVEN START
ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS
RATES ARE PER EXPOSURE HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.275, .415, .555)
LAMBDA = (1.2E-10, 8.9E-06, 4.3E-05)
LAMBDA$_+$ = (1.1E-30, 4.4E-06, 2.3E-05)
OMEGA = (2.2E-10, 5.7E-08, 2.2E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(2.8E-30, 1.1E-05, 5.8E-05)	(1.2E-07, 1.3E-05, 7.9E-05)	
2	(1.8E-30, 6.9E-06, 3.6E-05)	(1.2E-07, 1.2E-05, 6.9E-05)	(.000, .000, .460)
3	(1.5E-30, 5.6E-06, 3.0E-05)	(1.2E-07, 1.1E-05, 6.6E-05)	(.000, .000, .500)
4	(1.3E-30, 5.1E-06, 2.7E-05)	(1.2E-07, 1.1E-05, 6.5E-05)	(.000, .000, .445)
5	(1.2E-30, 4.8E-06, 2.5E-05)	(1.2E-07, 1.1E-05, 6.4E-05)	(.000, .000, .387)
6	(1.2E-30, 4.6E-06, 2.5E-05)	(1.2E-07, 1.1E-05, 6.4E-05)	(.000, .000, .315)
OVERALL	(1.2E-30, 5.6E-06, 5.8E-05)	(1.2E-07, 1.1E-05, 7.9E-05)	(.000, .000, .500)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(8.3E-29, 1.2E-06, 6.5E-06)		
3	(2.2E-28, 1.0E-06, 5.4E-06)	(2.5E-25, 4.8E-07, 2.5E-06)	
4	(3.9E-28, 9.3E-07, 5.0E-06)	(7.1E-25, 4.4E-07, 2.3E-06)	(1.7E-20, 2.3E-07, 1.1E-06)
5	(5.6E-28, 8.9E-07, 4.7E-06)	(1.3E-24, 4.3E-07, 2.2E-06)	(3.1E-20, 2.3E-07, 1.1E-06)
6	(7.0E-28, 8.7E-07, 4.6E-06)	(1.8E-24, 4.2E-07, 2.1E-06)	(4.3E-20, 2.2E-07, 1.1E-06)
OVERALL	(8.3E-29, 9.3E-07, 6.5E-06)	(2.5E-25, 4.4E-07, 2.5E-06)	(1.7E-20, 2.3E-07, 1.1E-06)

ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BAT, BWR MOTOR-DR HPCI
FAILURE TO OPERATE, GIVEN START
FAILURES ONLY, EXCLUDING COMMAND FAULTS
RATES ARE PER EXPOSURE HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.004, .246, .697)
LAMBDA = (2.9E-11, 7.0E-06, 3.5E-05)
$LAMBDA_+$ = (2.0E-08, 1.7E-07, 4.4E-07)
OMEGA = (2.2E-10, 5.7E-08, 2.2E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(7.2E-08, 7.5E-05, 3.8E-05)	(1.1E-07, 7.2E-06, 5.4E-05)	
2	(4.7E-08, 3.8E-05, 1.9E-05)	(9.8E-08, 7.1E-06, 5.4E-05)	(.000, .044, .560)
3	(3.9E-08, 2.5E-05, 1.3E-05)	(9.8E-08, 7.1E-06, 5.4E-05)	(.000, .044, .590)
4	(3.5E-08, 1.9E-05, 9.7E-06)	(9.8E-08, 7.1E-06, 5.4E-05)	(.000, .041, .593)
5	(3.2E-08, 1.5E-05, 7.8E-06)	(9.8E-08, 7.1E-06, 5.4E-05)	(.000, .038, .625)
6	(3.1E-08, 1.3E-05, 6.5E-06)	(9.8E-08, 7.1E-06, 5.4E-05)	(.000, .035, .629)
OVERALL	(3.1E-08, 2.5E-05, 3.8E-05)	(9.8E-08, 7.1E-06, 5.4E-05)	(.000, .041, .629)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(1.5E-09, 8.4E-08, 2.7E-07)		
3	(1.2E-09, 8.0E-08, 2.6E-07)	(5.3E-10, 6.8E-08, 2.4E-07)	
4	(1.0E-09, 7.8E-08, 2.6E-07)	(5.0E-10, 6.8E-08, 2.4E-07)	(3.7E-10, 6.3E-08, 2.3E-07)
5	(9.6E-10, 7.7E-08, 2.6E-07)	(4.9E-10, 6.8E-08, 2.4E-07)	(3.7E-10, 6.3E-08, 2.3E-07)
6	(9.0E-10, 7.7E-08, 2.6E-07)	(4.8E-10, 6.7E-08, 2.4E-07)	(3.6E-10, 6.3E-08, 2.3E-07)
OVERALL	(9.0E-10, 7.8E-08, 2.7E-07)	(4.8E-10, 6.8E-08, 2.4E-07)	(3.6E-10, 6.3E-08, 2.3E-07)

ALL FAILURES TO START IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, BWR MOTOR-OR HPCI

PLANT	CRIT. HOURS	CALEND. HOURS	POP	NUMBER OF INDIV. FAULTS FAILRS/COM FLTS	NUMBER OF NONLETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY NONLETHAL SHOCKS FAILRS/COM FLTS	NUMBER OF LETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY LETHAL SHOCKS FAILRS/COM FLTS
AR1	33594	53952	10	0 / 0	1 / 0	1 / 0	0 / 0	0 / 0
CR3	17695	32544	10	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0
DR1	13042	26808	9	0 / 4	1 / 1	1 / 1	0 / 0	0 / 0
DE1	45079	65328	10	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
DE2	37558	60384	11	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DE3	36816	53232	11	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RS1	29290	52968	9	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI1	31732	42192	9	0 / 3	1 / 0	1 / 0	0 / 0	0 / 0
TI2	3398	8784	9	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AR2	7068	15984	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	38451	52464	10	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
CC2	26811	33624	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FC1	47570	62712	10	2 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MI2	30580	43464	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MY1	55878	69600	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PA1	38960	76704	10	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
SL1	26228	38952	10	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
BV1	13775	38520	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC1	37510	49992	10	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DC2	16811	22464	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	63506	76704	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	37770	64536	10	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
IP3	25443	39336	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	16271	27576	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KE1	46125	57600	9	1 / 2	0 / 1	0 / 1	0 / 0	0 / 0
NA1	15859	21840	11	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
NA2	1724	2664	11	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	46464	59904	9	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	44184	50760	9	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PT1	62073	76704	9	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	64363	73104	9	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	59078	76704	9	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RO2	60180	76704	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

SA1	15488	33360	10	0 / 1	0 / 1	0 / 1	0 / 0	0 / 0
SE1	542	2112	12	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	56392	76704	9	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	42519	72336	11	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	35584	66360	11	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TR1	21998	42048	10	0 / 5	0 / 0	0 / 0	0 / 0	0 / 0
TU3	52966	69672	10	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
TU4	46080	64056	10	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
VR1	53515	76704	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	42451	63864	12	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	37666	59352	12	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AF1	32634	62448	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AF2	29788	54360	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AF3	26961	36360	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AP1	51445	76704	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AR1	22445	34896	7	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
AR2	27176	49528	7	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0
CO1	45502	57936	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DA1	35182	57216	7	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DR1	33786	59904	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	59693	76704	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR3	56458	76704	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN1	33105	53064	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN2	10147	19690	7	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
EP1	30779	51480	7	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MI1	58150	76704	9	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MO1	62706	76704	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NM1	58566	76704	8	0 / 4	0 / 0	0 / 0	0 / 0	0 / 0
OC1	55263	76704	8	1 / 0	0 / 1	0 / 2	0 / 0	0 / 0
PR2	40497	61728	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR3	40274	53928	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PI1	48238	72696	10	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
QC1	56398	76704	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC2	56912	73920	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
VY1	57426	74712	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	2577618	3567552	594[A]	13 / 38	3 / 8	3 / 11	0 / 0	0 / 0

A. THIS COUNTS SHARED PUMPS ONLY ONCE.

ALL FAILURES TO OPERATE, GIVEN START, IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, BWR MOTOR-DR HPCI

PLANT	CRIT. HOURS	CALEND. HOURS	POP	NUMBER OF INDIV. FAULTS FAILRS/COM FLTS	NUMBER OF NONLETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY NONLETHAL SHOCKS FAILRS/COM FLTS	NUMBER OF LETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY LETHAL SHOCKS FAILRS/COM FLTS
AR1	33594	53952	10	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CR3	17695	32544	10	2 / 0	0 / 2	0 / 4	0 / 0	0 / 0
DB1	13042	26808	9	4 / 4	0 / 2	0 / 2	0 / 0	0 / 0
DE1	45079	65328	10	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE2	37558	60384	11	5 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DE3	36816	53232	11	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RS1	29290	52968	9	4 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI1	31732	42192	9	1 / 0	0 / 1	0 / 2	0 / 0	0 / 0
TI2	3398	8784	9	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AR2	7069	15984	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	38451	52464	10	5 / 3	0 / 1	0 / 1	0 / 0	0 / 0
CC2	26811	33624	10	3 / 0	0 / 2	0 / 4	0 / 0	0 / 0
FC1	47570	62712	10	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MI2	30580	43464	10	3 / 0	0 / 1	0 / 1	0 / 0	0 / 0
MY1	55878	69600	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PA1	38960	76704	10	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SL1	26228	38952	10	6 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BV1	13775	38520	10	6 / 6	1 / 4	1 / 7	0 / 0	0 / 0
DC1	37510	49992	10	10 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DC2	16811	22464	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	63506	76704	10	6 / 0	0 / 1	0 / 1	0 / 0	0 / 0
IP2	37770	64536	10	15 / 1	0 / 0	0 / 0	0 / 0	0 / 0
IP3	26443	39336	10	11 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	16271	27576	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KE1	46125	57600	9	4 / 2	0 / 0	0 / 0	0 / 0	0 / 0
NA1	15859	21840	11	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA2	1724	2664	11	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	46464	59904	9	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	44184	50760	9	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT1	62073	76704	9	4 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	64363	73104	9	11 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	58078	76704	9	4 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RO2	60180	76704	10	15 / 4	0 / 2	0 / 3	0 / 0	0 / 0

SA1	16488	33360	10	1 / 0	0 / 3	0 / 3	0 / 0	0 / 0
SE1	542	2112	12	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	56392	76704	9	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	42519	72336	11	6 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	35584	66360	11	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TR1	21998	42048	10	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
TU3	52966	69672	10	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU4	46080	64056	10	2 / 2	0 / 0	0 / 0	0 / 0	0 / 0
YR1	53515	76704	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	42451	63864	12	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	37666	59352	12	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF1	32634	62448	7	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0
BF2	29788	54360	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF3	26961	36360	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BP1	51445	76704	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR1	22445	34896	7	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
BR2	27176	48528	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CO1	45502	57936	8	4 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DA1	35182	57216	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR1	39786	59904	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	58693	76704	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR3	56458	76704	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN1	39105	53064	7	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
EN2	10147	19680	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FP1	30779	51480	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI1	58150	76704	9	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MO1	62706	76704	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NM1	59566	76704	8	2 / 1	0 / 1	0 / 1	0 / 0	0 / 0
OC1	55263	76704	8	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
PB2	40497	61728	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB3	40274	53928	6	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PI1	48238	72696	10	0 / 3	0 / 1	0 / 1	0 / 0	0 / 0
QC1	56399	76704	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC2	56912	73920	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
VY1	57426	74712	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	2577618	3567552	594[A]	156 / 33	1 / 22	1 / 32	0 / 0	0 / 0

A. THIS COUNTS SHARED PUMPS ONLY ONCE.

ALL FAULTS IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, BWR MOTOR-OR HPCI

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
B	AR1	013015	070775	G	PM	B01	C		1		N	D	P36C M/U PUMP STARTED AND IMMED TRIPPED, PUMP FRZN	RAN WITH NO SUCTION, INCORRECT VLV LINE-UP
B	AR1	016195	100376	G	PM	D08			1		N	T	P36B STOPPED DUE TO OVR-CURRENT AND LOSS OF PRESS	EXCESSIVE INTERNAL COMPONENT WEAR
B	CR3	017938*	052977	I	PM	B00	V		2		N	U	CHEM ADD PMPS 3A & 3B FOUND INOP FOR PLANT S/U	CAUSE UNKN, PUMPS FLUSHED, RTND TO SERV
B	CR3	018400*	070977	I	PM	C11	V		2		N	D	DISCOVD CHEM ADD PMPS 3A & 3B INOP, PLANT AT POWER	PUMP BELIEVED AIRBOUND, VENT VLV INSTALED
B	CR3	021167	042578	R	PM	C15			1		M	D	LOW FLOW EXISTED ON DECAY HEAT REMOVAL PUMP 1-A	PUMP SHAFT SHEARED, BEING EVALUATED
B	CR3	022309*	080278	I	PM	C11	V		2		T	D	CHEM ADD PUMPS FAILED TO DEVELOP DISCHARGE PRESS.	CAP1A AND 1B BECAME AIRBOUND
B	CR3	025927	042379	I	PM	C00	R		1		N	U	CHEMICAL ADD PUMP FAILED TO PUMP (CAP-1B)	CAUSE UNKNOWN
B	DB1	019374	091777	G	PM	A19			1		N	D	MAKEUP PUMP 1-2 HAD OIL LEAK ON OTBD BRNG END PLT	O-RING ON END PLATE DID NOT FORM ADEQ SL
B	DB1	020277	011678	R	PM	B13	Y		1		T	T	DECAY HEAT PMP 1-1;FUSES IN BKR. START CKT.	POOR FUSE CONTACT IN CKT
B	DB1	021570	052878	R	PM	D01	T		1		N	D	POWER LOST TO DECAY HEAT PUMP 1-2,DH FLOW LOST	PERSONNEL TRIPPED PS BUSSES TO PUMP ACCI.
B	DB1	021859*	061578	R	PM	D02	T		2		N	D	POWER SUPPLY LOST 3 TIMES TO DECAY HEAT PUMP	2 PERSONNEL ERRORS
B	DB1	021858	061678	G	PM	D12			1		T	T	HORIZONTAL VIBRATION ON HPCI PUMP 1-1	PUMP WAS MISALIGNED DUE TO LOOSE MOUNTS
B	DB1	021959	071078	J	PM	D21			1		T	T	COMP COOLING WATER PUMP 1-1 HAD EXCESS. VIBRATION	FAILED AND IMP. CLEARANCES ON BEARINGS
B	DB1	022690	091578	J	PM	D01	U		1		N	D	COMP. COOLING WATER PUMP 2 TRIPPED	PERSONNEL DID NOT REOPEN HX OUTLET VALVE
B	DB1	025525A	010379	G	PM	C04	U		1		T	D	HPI PUMP 1-1 FAILED TO DEVELOP SUFFICIANT RECIRC	HEAT TRACE UNABLE TO MAIN LINE ABOVE FREZ
B	DB1	025525B	010379	G	PM	U04	U		1		T	D	HPI PUMP 1-2 MAY NOT HAVE HAD SUFF. RECIRC	HEAT TRACE UNABLE TO MAIN LINE ABOVE FREZ
B	DB1	025603	032979	G	PM	C09			1		N	D	MAKE UP PUMP 1-1 DEVELOPED VIB AND DECRE PERFORM.	FOREIGN DEBRIS FAILED WEARING RING
B	DB1	027857	110879	R	PM	B13	T		1		N	T	DHR PUMP 1 FAILED TO START	FAULTY SWITCH
B	DB1	027859	111279	G	PM	B05	S		1		T	D	HPI PUMP 1-1 FAILED TO START	FACTORY DEFECT IN CONTROL CIRCUIT WIRING
B	DB1	027918	120879	J	PM	B13	S		1		N	T	COMPONENT COOLING WATER PUMP #1 FAILED TO START	FAILED BREAKER AC113 ON BUS C1
B	DB1	031610	062380	G	PM	U01	C		1		N	D	HPI PUMP 1-1 BEARING THERMOCOUPLE WELLS BROKEN	ASSUMED TO BE STEPPED ON
B	DB1	032122	081380	R	PM	D02	S		1		N	D	DH PUMP 1-2 WAS STOPPED WHEN SUCTION VLV CLOSED	MAINTENANCE FAILED TO DEFEAT INTERLOCK
B	DE1	014806C	012876	G	PM	B02	U		1		T	D	HIGH PRESSURE INJECTION PUMP - INOPERABLE (1A)	INCORRECT SUBSTITUTE BREAKER INSTALLED
B	DE1	031669	061880	I	PM	C14			1		N	T	BORIC ACID TRANSFER PUMP DECLARED INOP	FAILED MOTOR, DIAPHRAM & VACUUM COMP VLV
B	DE2	031916	071380	G	PM	D21			1		N	T	2B HPI PUMP REMOVED FROM SERVICE	RAD BEARING CAUSE NOT STATED

ALL FAULTS IM ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TO, BWR MOTOR-DR HPCI

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
B	DE2	033125	072680	G	PM	D18		R		1	N	U	2B HPI PUMP DECLARED INOPERABLE,DEVELOPED HOT BEAR	UPWARD PRESSURE OF MOTOR AGAINST UP BEAR.
B	DE2	032153	073080	I	PM	C00		R		1	N	U	BORIC ACID TRANSFER PUMP DECLARED INOPERABLE	CAUSE NOT STATED
B	DE2	032311	080580	I	PM	C09		T		1	N	T	BORIC ACID XFER PUMP UNABLE TO PUMP DOWN LOST	STRAINER WAS BLOCK
B	DE2	032430	082280	I	PM	D14				1	N	T	CON BORIC ACID STORAGE TANK PUMP DECLARED INOPER.	WORN WORM GEAR,BAD GASKET,& TORN OIL SEAL
B	DE2	0327768A	092890	I	PM	C00				1	N	U	CBAST PUMP FAILED TO PUMP FROM CBAST TO LOST	LOW OIL LEVEL IN PUMP,CAUSE NOT GIVEN
B	DE2	0327768	093090	I	PM	B01	S			1	N	D	CBAST PUMP DECLARED INOPERABLE	COUNTER NOT RESET
B	RS1	014502	032376	G	PM	D00				1	N	U	HPCI P238A TRIPPD OFF LINE WHEN AT 100% POWER	NO CAUSE COULD BE FOUND THRU TESTING
B	RS1	016012	082276	R	PM	A19		R		1	T	T	EXCESS LEAKAGE ON B PMP OF DECAY HEAT DURNG SRVLNC	LEAK CAUSD BY STUFFING BOX GASKET
B	RS1	021744	062278	R	PM	A19		R		1	N	T	B DHR PUMP SEAL FOUND LEAKING	LEAKING SEAL REPLACED
B	RS1	030263	011790	R	PM	A19				1	N	T	LEAKAGE OBSERVED FROM 'A' DHR PUMP SEAL	SEAL WAS REPLACED
B	TI1	011016	101074	G	PM	B02	S			1	T	D	MAKEUP PUMP 1A TRIPPED ON MANUAL ACTUATION	WRONG LUG USED TO CONN FOR CBL TO MTR WDG
B	TI1	011015	101774	G	PM	B13	S			1	T	D	MAKEUP PUMP 1C FAILED TO START - AUTOMATIC	WESTINGHSE ACB HAD DISLGD TRIP LTCH SPRNG
B	TI1	012103	010375	G	PM	B13	S			1	T	D	HIGH PRESS INJ PUMP MU-P1C FAILED TO START	LOOSE TERMINATION ON BRKR RELEASE
B	TI1	014220	021776	G	PM	B06	C			1	T	D	"A" MAKEUP/PURIF PMP STARTED WITH IMPROPR VALV L/U	PMP FAILURE DUE TO INAD PROCEDRES/PERSONL
B	TI1	020997*	031878	G	PM	D13	U			2	T	D	THE 1A & 1C MAKEUP PMPS TRIPPED ON XFER TO SITE PR	MALFUNC TIME DELAY RELAY IN LOW L.O. CKT
B	TI1	025503	021779	G	PM	D18				1	T	T	HPI PUMP MU-P-1C TRIPPED ON OVERLOAD	FAILED LEAD INSIDE PUMP MOTOR
C	CC1	012449	021675	J	PM	B13	S			1	T	D	NO 11 CCW FAILD TO START UPON SIS SIGNAL	RELAY IN ESFAS BURNED CONTACTS
C	CC1	013189	080175	G	PM	A19		R		1	U	U	#13 CHARGING PUMP RELEASED GAS ACT TO AUX BLDG	PLUNGER PKG LKG (UTEX INDUS. PART# SF1943)
C	CC1	013389	091175	G	PM	A19		R		1	U	U	#13 CHG PUMP RELEASED GAS ACT FROM UA-1 MAIN VENT	PLUNGER PACKING LEAKED EXCESSIVELY
C	CC1	014754	050476	G	PM	D00		S		1	N	U	#13 CHARGN PUMP TRIPPD DUE TO BREAKER OPENING	CAUSE FOR OPENING OF BKR. UNKNOWN
C	CC1	018485	072977	G	PM	A19		R		1	N	T	#12 CHARGING PUMP REMOVED FROM SERVICE	REPAIR SLOWLY INCREASING PACKING LEAK
C	CC1	019688	111377	G	PM	A19		R		1	N	T	#12 CHG PUMP S/D AND ISOLATED	EXCESSIVE PACKING LEAKAGE. PACKING FAILED
C	CC1	020358	012378	R	PM	C13		S		1	N	D	#12 LPSI COULDN'T BE TRIPPD FROM CONTROL RM	MISSING SCREW IN TRIP ACT. LEVER ON BREKR
C	CC1	026235	050779	R	PM	D03		U		1	N	D	#11 LPSI PUMP WAS STOPPED WHILE IN RHR MODE	SPURIOUS RECIRC ACT SIG BY PERSONNEL TEST
C	CC1	026718A	080679	G	PM	D13		S		1	N	T	#12 CHARGING PUMP TRIPPED ON LOW SUCITON PRESSURE	FAULTY PRESSURE INDICATING SWITCH

ALL FAULTS IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, BWR MOTOR-DR HPCI

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
C	CC1	0267188	080679	G	PM	A19			1		N	T	#11 CHARGING PUMP ISOLATED DUE TO LEAK	PACKING FAILED
C	CC2	017049	013177	G	PM	C14			1		N	T	FLOW FROM #21 CHG PMP DECREASED TO ABOUT 39 GPM	INVEST REVEALED TWO DISCH VLVS BROKEN
C	CC2	022604*	022478	R	PM	D13	U		2		N	T	BOTH LPSI PUMPS TRIPPED BY RAS SIGNAL	LEVEL INDICATOR FOUND TO BE OUT OF CAL.
C	CC2	022646*	101778	R	PM	C06	U		2		N	D	BOTH 21 AND 22 LPSI PUMPS LOST SUCTION	AIR LEAKED FROM PURIFICATION SYS TO SDC
C	CC2	023173*	121278	G	PM	A19			2		N	T	21 AND 22 CHARGING PUMPS HAD EX PRI PACKING LEAKS	PACKINGS REACHED EOL SIMULTANEOUSLY
C	FC1	000613	112073	J	PM	U04	R		2		U	T	COMPONENT COOLING WATER IMPELLER CRACKING	CAST IRON IMPELLERS CHANGED TO BRONZE
C	FC1	012513	040375	G	PM	B09	S		1		T	T	CHARGING PUMP CH-1C FAILD TO START	DIRTY TIMING RELAY CONTACTS
C	FC1	032766	092680	G	PM	D19	S		1		N	T	"A" CHARGING PUMP BECAME INOPERABLE	PACKING COOLING WATER PUMP FAILED
C	MI2	014602	050276	G	PM	C19			1		T	T	"A"CHARGING PUMP NO FLOW ON AUTOMATIC START	GROSS PACKING LEAKS
C	MI2	017374	121276	G	PM	D00			1		N	U	"C" CHARGING PMP TAGGD OUT DUE TO EXCESSIVE NOISE	UNKNOWN
C	MI2	025576	031479	R	PM	C11	U		1		N	D	LPSI PUMP LOST SUCTION DURING S/D COOLING	PUMP BECAME AIRBOUND
C	MI2	030796	031080	G	PM	A19			1			T	CHARGING PUMP PLACED OUT OF SERVICE	PACKING FAILED,NATURAL END OF LIFE
C	MY1	021039	030278	G	PM	D02			1		T	T	1A CHARGING PMP STARTD FOR VIBRATN TEST--HI TEMP.	LOCKN PIN NOT INSTLLD TO BEARING
C	PA1	000202	072773	J	PM	D15			1		U	D	COMPNT COOLNG PMP P52C COUPLING FAILED	TEETH ON HUB STRIPPED
C	PA1	014719	042176	G	PM	B09			1		T	T	CHARGING PUMP P55-A WOULD NOT START PROPERLY	PLUGGED OIL FILTER
C	PA1	015311	072076	J	PM	D20			1		N	U	CCW PMP P52-C INBORD BRNG FAILD SHAFT METALLIZED	EITHER HOT END ALIGMNT OR BRNG SLIPPAGE
C	PA1	021117	041778	G	PM	B13	S		1		N	D	CHARGING PUMP P-55B WOULD NOT START	FAULTY CONTROL COIL IN CIRCUIT BREAKER
C	PA1	022913	103178	G	PM	A19			1		N	T	CHR PUMP P-55C TAKEN OUT OF SERVICE	LEAKING SEALS
C	SL1	017394A	022077	G	PM	D00	R		1		N	U	B CHG PMP SEAL LUBE WTR PMP FAILED DURING R/X S/U	MODEL SD11,TYPE 102,STYLE CZOOV
C	SL1	017394B	022077	G	PM	D00	R		1		N	U	A CHG PMP SEAL LUBE WTR PMP FAILED DURING R/X S/U	MODEL SD11 TYPE 102 PART#78 15157
C	SL1	017393	022677	G	PM	C00	R		1		N	J	DURING POWER OPS,A CHRGNG PMP SEAL LUBE WTR FAILED	FAILD TO DELIVER SUFFICIENT FLOW
C	SL1	023658	090278	G	PM	A16	R		1		M	T	CHR PUMP 1A FOUND TO HAVE SMALL CRACK IN BLOCK	CAUSE OF CRACK IS UNKNOWN
C	SL1	022649	100278	G	PM	B13	S		1		N	D	1B CHARGING PUMP FAILED TO START	ELEC INTER READ O SUCTION PRESSURE
C	SL1	025595	031679	G	PM	A16	R		1		N	T	1C CHARGING PUMP DEVELOPED CRACKED PUMP CASING	SUCTION CAVITATION & VIBRATION
C	SL1	032587A	082880	G	PM	A00	R		1		M	U	SEAL WATER LEAK DEVELOPED IN 1B CHR PUMP	CAUSE NOT STATED

ALL FAULTS IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, BWR MOTOR-DR HPCI

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
C	SL1	032587C	082880	G	PM	B00		S	1		N	T	1A CHR PUMP STARTED THEN APPARENTLY STOPPED	FAILED SEAL WATER PUMP
W	BV1	015214	070876	R	PM	A19			1		N	T	A RUPTURED SEAL WAS DISCOVERED ON 1A RHR PUMP	SEAL BOUND ON PUMP SHAFT CAUSING FAILURE
W	BV1	0167518	121576	G	PM	A14		R	1		N	T	1C CHARGNG PMP LEAKING AT SPEEDINC. GEAR CASING	TUBE FAILURE OF L.O. COOLER
W	BV1	0167518	121576	G	PM	A14		R	1		N	T	1B CHARGNG PMP LEAKING AT GEAR CASING	TUBE FAILURE OF L.O. COOLER
W	BV1	018348	070577	G	PM	D15			1		N	U	1B CHARGING PUMP TRIPPED ON PHASE OVERCURRENT	PUMP SHAFT CRACKED AT BALANCE DRUM NUT
W	BV1	021356A	041678	G	PM	D09		S	1		N	T	1B CHARGN/SI PUMP HI BEARING TEMP ALARM	PLUGGED OIL PUMP COOLERS-WATER SIDE
W	BV1	0213568	041678	G	PM	D09		S	1		N	T	1C CHARGE/SI PMP HI BEARING TEMP ALARM PLGGD COOL	RIVER WATER STRAINERS TORN ALLOWING DEBRI
W	BV1	021646	042178	G	PM	D01		S	1		N	D	1C CHG PUMP TRIPPED, NO BACK-UP WAS AVAILABLE	OPERATOR MADE IMPROPER ELEC LINE-UP
W	BV1	022396*	090478	R	PM	C11		V	2		N	D	A AND B RHR PUMPS WERE RUNNING WITH NO DISCH FLOW	PUMPS BECAME AIR BOUND WITH RCS DRAINED
W	BV1	023145	010379	G	PM	C14			1		N	T	1C CHARGING PUMP HAD LOW DISCHAGE PRESSURE	FAULTY ROTATING ELEMENT
W	BV1	026481	070379	R	PM	D13		S	1		N	D	RHR PUMP WAS TRIPPED FROM CONT ISOLATION PHASE B	POWER SUPPLY SWITCHING CAUSE VOLT SPIKE
W	BV1	026841	081679	G	PM	D02		C	1		T	D	1C CHARGING PUMP BECAME INOPERABLE	FAILED BEARING DUE TO A COOLING VLV SHUT
W	BV1	030552	013180	I	PM	D13		S	1		N	T	BORIC ACID TRANSFER PUMP TRIPPED ON OVERLOAD	POSSIBLE FAULTY BLENDER CONTROLS,CH-P-2B
W	BV1	030879*	040880	R	PM	C06		V	2		N	D	RHR PUMPS BECAME AIRBOUND WHILE INCREASING FLOW	PROCEDURE REVISED TO VENT PUMPS
W	BV1	030880*	041180	R	PM	C11		V	2		N	D	*A* AND *B* RHR PUMPS COULD NOT DEVELOP FLOW	PUMPS BECAME AIRBOUND
W	BV1	031790	062980	I	PM	D03		S	1		T	D	BORIC ACID TRANSFER PUMP TRIPPED	PERSONNEL TESTED BKR INCORRECTLY
W	BV1	032789	091780	G	PM	D02		U	1		T	D	1C HIGH HEAD CHARGING PUMP BEARING TEMP INCREASED	CHECK VALVES INSTAL BACKWARDS IN COOL H2O
W	BV1	032853	093080	I	PM	A19			1		N	T	2A BORIC ACID PUMP DEVELOPED LEAK (CH-P-2A)	WORN MECHANICAL SEAL,CRACK FOUND ON SHAFT
W	DC1	013078	070375	I	PM	C09			1		T	T	BOR ACID XFER PMP #2 FLOW 17.5 GPM, SPEC IS 20 GPM	BORIC ACID CRYSTALS IN VLVS & PIPES
W	DC1	013076	072075	I	PM	C19		R	1		N	D	#1 BOR ACID XFER PMP COULD NOT MEET DESIGN FLOW	MECHANICAL SEAL FAILED
W	DC1	013443	082475	I	PM	A19		R	1		N	D	#2 BOR ACID XFER PMP TAKEN OUT OF SERV, EXSV LKG	JOHN CRANE MECHANICAL SEAL FAILED
W	DC1	013410	092775	I	PM	A19		R	1		N	D	#2 BOR ACID XFER PMP TAKEN OUT OF SERV, EXSV LKG	JOHN CRANE MECHANICAL SEAL FAILED
W	DC1	013540	101775	I	PM	A19		R	1		N	D	#1 BOR ACID XFER PMP TAKEN OUT OF SERV, EXSV LKG	JOHN CRANE MECHANICAL SEAL FAILED
W	DC1	013541	102075	I	PM	A16			1		N	D	#1 BOR ACID XFER PMP TAKEN OUT OF SERV, CSNG SEPG	DAMAGE TO GASKET SEALING SURF ON CASING
W	DC1	017650	040777	G	PM	D15		R	1		N	D	1W CENT CHG PUMP AMMTR PEGGED, PUMP DEENERGIZED	BROKEN SHAFT.CLEAN BRK UNDR 11TH STG IMP

ALL FAULTS IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, BWR MOTOR-DR HPCI

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	DC1	017670	041877	G	[illegible]			S		1	N	D	"W" CHARGN PMP HIGHER THAN NORMAL CASING TEMPERATR	RAG STUCK IN RECIRC LINE DURIN ROTOR REPL
W	DC1	017769	051777	G	[illegible]	015	[illegible]			1	N	D	EAST CENT CHG PMP BRK BET 3RD & 4TH STG IMPELLERS	BREAK APPEARED TO BE A FATIGUE FAILURE
W	DC1	020067	122277	J	[illegible]						T	D	WEST COMP COOL WTR PMP FAILD TO START (MANUAL)	WIRE BROKEN AT TERMINAL BLOCK;HOT S/D PAN
W	DC1	020310	011678	[illegible]	[illegible]	[illegible]	C49			1	T	T	#2 BOR ACID XFER PMP DISCH PRESS LOWER THAN REQD	LEAKING MECH SHFT SL. ATTRIB TO NOR WEAR
W	DC1	031811	070380	G	PM	D10	R			1	N	D	TRAIN B CENTRIFUGAL CHR PUMP FAILED WHILE OPER.	SHAFT BROKE
W	HN1	014163	012476	G	PM	A19				1	N	T	EXCESSIVE SEAL LEAKAGE ON 1A CENT CHARGING PUMP	OUTBD SEAL HAD "O" RING FAILURE
W	HN1	015097	061776	R	PM	D06	U			1	N	D	R/X SHUTDOWN & REFUELING LOST PWR TO RHR PMP--2MIN	OVERLOADED 480V BUS PROCEDURES DEFICIENT
W	HN1	016041	100176	I	PM	D21				1	N	T	1A BAT DEVELOPED LEAK IN CANNED ROTOR DUE TO BRNGS	WIPED BRNGS ALLWD ROTOR TO DROP & WEAR
W	HN1	017426	030477	I	PM	D09				1	N	T	1A BAT OVERHEATD & SEIZED DUE TO BEARING FAILURE	FOREIGN MATERIAL ENTERED MOTOR BEARING
W	HN1	017569	040477	G	PM	C20				1	N	T	"A" CHGNG PUMP INDICATIONS POINTED TO FAULTY OPS	DISASSY REVEALED CRKS UNDER PRESS RED SLV
W	HN1	017689	042677	G	PM	A05				1	M	D	1A CHG PMP DEVELOPED SMALL WEEP ON SUCT MECH SEAL	SLIGHT POROSITY BTWN SL SPLY PSG & SL SUR
W	HN1	017688	042877	G	PM	D20				1	N	T	1A CHARGING PMP AXIAL MISALIGNMNT OF MTR TO PUMP	EXCESS THRUST WIPED MOTOR BEARING RAN 20M
W	IP2	013170*	072275	G	PM	A19	R			1	N	D	2 CHG PMPS REMOVED FROM SERVICE	EXCSV PLUNGER SEAL LEAKAGE
W	IP2	013299*	082775	G	PM	A19	R			1	N	D	2 CHG PMPS REMOVED FROM SERVICE	EXCSV PLNGR SEAL LKG.- VAR SPD 98GPM
W	IP2	013300*	082975	G	PM	A19	R			1	N	D	2 CHG PMPS REMOVED FROM SERVICE	EXCSV PLNGR SEAL LKG - PSBLE DESIGN MOD
W	IP2	013432	090475	I	PM	A19	R			1	N	T	BOR ACD XFER PUMP # 21 REMOVED FROM SERVICE-TYPE 1	BELLOW SHAFT SEAL LKG - DWG FSP 10443-7
W	IP2	013609	101475	I	PM	A19	R			1	N	T	BOR ACD XFER PUMP #22 REMOVED FROM SERVICE -TYPE 1	BELLOW SHAFT SEAL LKG - DWG FSP 10443-5
W	IP2	013739A	110575	G	PM	A16	R			1	N	D	NO. 23 CHG PUMP REMOVED FROM SERVICE	LEAKING HEAD GASKET - TYPE QX-300 QUNTPLX
W	IP2	013739B	110575	G	PM	A19	R			1	N	D	NO. 22 CHG PUMP REMOVED FROM SERVICE	EXCSV PLNGR SEAL LKG - TYPE QX-300 QUNTPX
W	IP2	013850	120375	G	PM	A16	R			1	N	D	NO. 21 CHG PUMP REMOVED FROM SERVICE	LKG HEAD GSKT - TYPE GX-300 QUINTUPLEX
W	IP2	014003A	121875	G	PM	A16	R			1	N	D	NO. 21 CHG REMOVED FROM SERVICE	PIN HOLE LEAK IN FLUID HEAD
W	IP2	014003B	121879	G	PM	A16	R			1	N	D	NO. 23 CHG REMOVED FROM SERVICE	LARGE LEAK IN FLUID HEAD
W	IP2	014449	031276	I	PM	A19	R			1	N	T	BOR ACD XFER PUMP REMOVED FROM SERVICE	BELLOW SEAL LKG - CRACKED ROT SEAL SURFCE
W	IP2	0187878	050777	J	PM	B13	S			1	T	D	#22 AUX COMP COOL WTR PMP FAILD TO START DURIN ST	DIRTY CONTACTS ;PLANT IN COLD SHUTDOWN
W	IP2	019236	052677	G	PM	C15				1	N	U	#22 CHG PUMP DEVELOPED LOUD NOISE - LOST DISCH PRS	FLUID DRIVE CPLNG FOUND BROKEN

ALL FAULTS IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, BWR MOTOR-DR HPCI

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	IP2	019239	090977	I	PM	A19		R	1		N	T	#22 BOR ACID XFER PUMP REMOVED FROM SERVICE	TYPE 1, BELLOWS SHAFT SEAL WAS LEAKING
W	IP2	021333	050278	J	PM	B00			1		T	U	NO. 22 AUX COMP COOLING PUMP FAILED TO START	CAUSE UNKNOWN, FOUND DOING SI SYS TEST
W	IP2	022721	090878	I	PM	A19		R	1		N	T	NO. 22 BORIC ACID TRANS PUMP DECLARED INOPERABLE	FAILED MECHANICAL SEAL
W	IP2	023580	121478	G	PM	A16		R	1		M	T	CH. PUMP #22 HAD LEAKAGE AT GLAND STUFF BOX GASKET	FOUND CRACK IN FLUID HEAD AND CYL. WALL
W	IP2	025227	020679	I	PM	D13		S	1		N	T	NO. 22 BORIC ACIC TRANSFER PUMP BECAME INOPERABLE	FAILED CONTROL TRANSFORMER
W	IP3	019265	092577	G	PM	A16		R	1		N	U	#32 CHG PUMP DEVELOPED LEAK IN HEAD - TAKEN OFF-LN	HAIR-LINE CRACK IN HEAD - 98 GPM, QX-300
W	IP3	019264	093077	G	PM	A19		R	1		N	U	#33 CHG PUMP TAKEN OUT OF SERVICE	EXCSV SEAL LEAKAGE - TYPE QX-300 QUINTPLX
W	IP3	019262	100177	G	PM	A19		R	1		N	U	#31 CHG PUMP TAKEN OUT OF SERVICE	EXCSV SEAL LEAKAGE - TYPE QX-300 QUINTPLX
W	IP3	019283	100577	I	PM	A19		R	1		N	U	#32 BOR ACID XFER PUMP REMOVED FROM SERVICE	LEAKING BELLOWS SHFT SL - CRANE, TYPE 1
W	IP3	019282	100677	I	PM	A16		R	1		N	U	#32 BOR ACID XFER PUMP REMOVED FROM SERVICE	LEAKING SUCTION FLANGE GASKET - MOD 3196
W	IP3	020122	121677	G	PM	A19		R	1		N	U	#33 CHG PUMP REMOVED FROM SERVICE	EXCSV SEAL LEAKAGE - 98GPM TYPE QX-300
W	IP3	021359	041678	G	PM	A19		R	1		N	U	#31 CHG PUMP REMOVED FROM SERVICE	EXCSV SEAL LEAKAGE - QX-300 QUINTUPLEX
W	IP3	022411	081578	R	PM	A19			1		N	T	NO. 32 RHR PUMP SEAL FOUND LEAKING	SEAL SURFACES FOUND WORN
W	IP3	022877	102778	G	PM	A14		R	1		N	T	LEAKAGE OBSERVED FROM NO. 31 CHARING PUMP	LEAK WAS FOUND IN PLUNGER
W	IP3	025232	020579	G	PM	A19		R	1		N	T	# 32 CHARGING PUMP DISCOVERED LEAKING	FAILED PLUNGER AND PACKING
W	IP3	026479	071579	I	PM	A19		R	1		N	T	#32 BORIC ACID TRANSFER PUMP DEVELOPED LEAK	MECHANICAL SEAL WAS REPAIRED
W	KE1	010644	081974	J	PM	B02	U		1		N	D	COMP COOL PMP 1A DID NOT START PM ON 8/16/74	CKT BKR NOT RACKED IN FULLY
W	KE1	016686	122276	I	PM	D00			1		N	U	BOR ACID PUMP 1A TRIPPED AND WOULD NOT RESTART	BKR OVLDS TRIPPED, RESET - NO OTHR PROBLM
W	KE1	018882	081777	J	PM	B13	S		1		M	D	COMP COOL PMP WOULD NOT START AFTER PM WORK DONE	TRIP ARM HITTING TRIP ROD;READJUSTED, LUBE
W	KE1	019311	100277	G	PM	D18		R	1		N	D	FLOW FROM OPERATING CHG PMP WAS LOST DURING OPERTN	BROKEN BELT ON VARI-DRIVE UNIT
W	KE1	019643	110777	G	PM	D18		R	1		N	D	FLOW FROM OPERATING CHG PMP WAS LOST DURING OPER	BROKEN BELT ON VARI-DRIVE UNIT
W	KE1	020339	011578	J	PM	B13	S		1		N	D	CC PUMP FAILD TO START DURIN FULL POWER OPERATION	FAULTY STATIC TRIP DEVICE IN CKT BREAKER
W	KE1	020338	011878	J	PM	B00			1		N	U	CC PUMP FAILD TO START DUE TO OVERCURRENT TRIP	UNDER INVESTIGATION CAUSE NOT DETERMINED
W	KE1	022237	080978	G	PM	C13	S		1		N	T	CCP OPERATED ONLY AT HIGH SPEED	FAILED TRANSISTOR IN HAND CONTROL STATION
W	KE1	022540	091878	G	PM	A16			1		N	T	LEAK DEVELOPED ON CCP BETWEEN DIS. PIPE AND BLOCK	CRACK CAUSED BY OPERATING STRESS

ALL FAULTS IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, BWR MOTOR-DR HPCI

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	KE1	030562	021180	G	PM	D13		S	1		N	F	CHARGING PUMP STOPPED WHEN CONTROL SW PLACED AUTO	STICKING CONTACT
W	NA1	022033	071778	G	PM	D02			1		N	D	CHP PUMP 1C BECAME INOPERABLE	IMPROPERLY ASSEMBLED SEAL ASSEMBLY
W	NA1	025716	040879	G	PM	U01	U		1		N	J	1A&1B OOS FOR MAINT, 1C FEEDER BRKR NOT RACKED IN	IMPROPER TAGOUT PROCEDURE
W	NA1	027248	092879	G	PM	C00			1		T	J	CHARGING PUMP 1-CH-P-1A DID NOT FUNCTION	CAUSE NOT STATED
W	PR1	018807	062877	G	PM	D13			1		N	U	CHARGING PUMP FAILED	CAPSCREW FAILURE IN VARIDRIVE UNIT
W	PR2	030733	031280	G	PM	B13		S	1		N	D	NO. 22 CHR PUMP MOTOR BKR KEPT TRIPPING	BREAKER FAILURE, BKR REPLACED
W	PR2	031631	061580	G	PM	B13		S	1		N	D	NO. 23 CHR PUMP STARTED AND SOON SHUTDOWN	AIR LEAKS IN SPEED CONTROL UNIT
W	PT1	016772*	030876	G	PM	D18		R	2		N	T	CHARGING PUMPS "B" AND "C" FAILED	BROKEN VARIDRIVE BELTS - VARIBELT NO. 842
W	PT1	016709	123076	G	PM	A19			1		N	T	C CHRGNG PMP OOS DUE TO PLUNGER LEAKAGE	PACKNG WEAR AJAX IRON WORKS TYPE T-125
W	PT1	027043	091279	G	PM	C16		R	1		U	D	THE 1-P2B CHR PUMP FOUND TO HAVE CRACKED CYL BLOCK	PRESSURE SPIKING FOLLOWING H2 SEPARATION
W	PT2	017248A	022176	G	PM	A19		R	1		N	T	2P2C CHARGING PUMP TAKEN OUT OF SERVICE	REPAIR PLUNGER LEAKAGE
W	PT2	017248B	022176	G	PM	D18		R	1		N	D	2P2B CHARGING PUMP FAILED	BROKEN VARIDRIVE BELT - VARIBELT NO. 842
W	PT2	016154A	092076	G	PM	A19		R	1		N	T	"C" CHARGING PUMP TAKEN OUT OF SERVICE	REPAIR MINOR PLUNGER LEAKAGE
W	PT2	016154B	092076	G	PM	D18		R	1		N	D	"B" CHARGING PUMP FAILED	BROKEN VARIDRIVE BELT - VARIBELT NO. 842
W	PT2	020461A	022177	G	PM	A19		R	1		N	T	2P2C CHARGING PUMP TAKEN OUT OF SERVICE	REPAIR PLUNGER LEAKAGE
W	PT2	020461B	022177	G	PM	D18		R	1		N	D	2P2B CHARGING PUMP FAILED	BROKEN VARIDRIVE BELT - VARIBELT NO. 842
W	PT2	020713D	040677	G	PM	C04		R	1		U	T	CHR PUMP "C" DISCOVERED TO HAVE CVC BLOCK CRACK	PULSATIONS CAUSED CRACKING
W	PT2	017722	042077	G	PM	C00			1		N	U	CHRGNG PMP UNABLE TO DELIVR SUFFCNT FLOW	NOT YET DETERMINED INVESTIGATIONS CONT
W	PT2	017839	051677	G	PM	B21			1		N	U	2P2B CHRGNG PMP OOS DUE FOR INSPECTION OF NOISY BR	BRNG FOUND SERVICEABLE
W	PT2	020713B	022878	G	PM	C04		R	1		M	T	CHR PUMP "B" DICCOVERED TO HAVE A CYL BLOCK CRACK	INSTLLTN OF PULSATION DAMPNERS PLANNED
W	PT2	020713C	030178	G	PM	C04		R	1		M	T	CHR PUMP "C" DISCOVERED TO HAVE A CYL BLOCK CRACK	INSTLLTN OF PULSATION DAMPNERS PLANNED
W	PT2	020974	031378	G	PM	D18		R	1		N	T	A CHRGING PMP OOS TO REPLACE BELT	BROKEN VARIDRIVE BELT
W	RG1	013996	011276	J	PM	D15			1		N	T	"B" COMPONENT COOLING WATER PUMP WAS NOISY	DAMAGED COUPLING - LOOSE BOLTS, MOD D8Z226
W	RG1	018225	061977	G	PM	D18		R	1		N	T	"C" CHARGING PUMP VARIDRIVE FOUND SMOKING	BELTS REPLACED - VARIDRIVE PART 84-2
W	RG1	025064	010479	G	PM	A16			1		N	T	"A" CHARGING PUMP FOUND LEAKING	BLOCK REPLACED, HIGH HOOP STRESSES

ALL FAULTS IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, BWR MOTOR-OR HPCI

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W	RG1	025065	010479	G	PM	C18		R	1		N	T	'B' CHARGING PUMP SPEED CONTROL NOT OPERATING PROP	VARIDRIVE BELT SLIPPING AT LOW SPEEDS
W	R02	000609	120473	I	PM	D04		R	1		U	T	BORIC ACID XFER PMP B SHAFT BROKE AT IMPELLER	GENERIC DESIGN PROBLEM - TYPE GE-20K
W	R02	000898	032074	I	PM	D04		R	1		N	D	BORIC ACID XFER PMP B BKR TRPD ON THERMAL OVLD	PUMP HAD BROKEN SHAFT - DESIGN PROBLEM
W	R02	010112	032074	I	PM	D00		R	1		N	U	BORIC ACID XFER PMP B FOUND TRIPPED ON ROUTINE INS	CAUSE UNKNOWN
W	R02	010091	040674	I	PM	D04		R	1		N	D	BORIC ACID XFER PUMP A FAILED DURING NORMAL OPER	SHAFT BROKE IN VICINITY OF IMPELLER
W	R02	010476	080874	I	PM	D04		R	1		N	D	BORIC ACID XFER PUMP B FAILED DURING 100% PWR OPS	PUMP SHAFT BROKEN - DESIGN PROBLEM
W	R02	010519	081574	I	PM	D04		R	1		T	D	BORIC ACID XFER PUMP B FAILED DURING PERIODIC TEST	PUMP SHAFT FAILED - DESIGN PROBLEM
W	R02	010803	092674	I	PM	D04		R	1		N	D	BORIC ACID XFER PUMP B FAILED DURING 100% PWR OPS	PUMP SHAFT BROKE AT JUNCTURE WITH ROTOR
W	R02	011088	120474	I	PM	D21		R	1		U	D	BORIC ACID XFER PUMP B FAILED AT PUMP-ROTOR END	MAY BE CAUSED BY BEARING WEAR
W	R02	012078	011475	I	PM	D04		R	1		N	D	BORIC ACID XFER PMP A FAILED DURING 100% PWR OPS	PUMP SHAFT FAILED - DESIGN ERROR
W	R02	012300	012675	J	PM	D13		S	1		N	D	OVERCURRENT TRIP OF "C" COMP. COOLN WTR AT 100% PW	FAILD STATUS LITE;TRIED SEVERAL STARTS
W	R02	012738	052175	I	PM	D04		R	1		N	D	BORIC ACID XFER PMP B STOPPED SHORTLY AFTER START	PUMP MOTOR SHAFT BROKEN - DESIGN PROBLEM
W	R02	012975	062575	I	PM	D04		R	1		N	D	BORIC ACID XFER PMP A FAILED DURING NORMAL OPS	PUMP SHAFT FAILED AT KEYWAY - DESIGN PROB
W	R02	014820	010276	I	PM	D21		R	1		N	T	BAT "B" FAILD DAMAGED ROTOR---SERIES G,MODL GE-20K	FAILD REAR GRAPHITE BEARING
W	R02	014830	041276	I	PM	D02		T	1		N	D	"B" BAT PUMP TRIPPD AT 100% PWR	HEATER TRIPS SET AT 250 DEG F
W	R02	016206	101876	I	PM	D18		R	1		N	T	BAT "B" FAILD HI TEMP CUTOUT TRIPPD PUMP	DEFECTIVE STATOR AND BEARINGS WORN
W	R02	016259	102976	I	PM	D02		T	1		N	D	BATP B TRIPPED ON HI PUMP MOTOR TEMP CUTOUT	HEAT TRACING CIRCUIT TEMP SET TOO HIGH
W	R02	017098	012477	I	PM	D09			1		N	D	BATP B TRIPPED ON HI MOTOR TEMP CUTOUT	RECIRC LINE PLUGGED WITH SOLID BORIC ACID
W	R02	017099	013177	I	PM	D02		S	1		N	D	BATP B TRIPPED ON HI MOTOR TEMP CUTOUT	TEMP CUTOUT SET TOO LOW FOR NORMAL OPS
W	R02	018138*	060777	G	PM	C11		V	2		N	D	B & C CHGNG PUMPS RUNNING - PSZR LVL STILL FALLING	PUMP AIR BOUND - TYPE TX-150
W	R02	019345	062277	G	PM	C11		V	1		N	D	"C" CHGNG PMP WOULD NOT CONTROL PSZR LEVEL	PUMP WAS AIR BOUND - TYPE TX-150
W	R02	025816	040279	I	PM	D15			1		N	T	BORIC ACID TRANSFER PUMP KEPT TRIPPING,PUMP 'B'	BROKEN SHAFT,PUMP REPLACED
W	SA1	0177008	050677	G	PM	U01	U		1		R	D	BOTH SI PUMPS AND 1 CENTRIFUGAL CHG PMP TAGGED OUT	PERSONNEL ERROR - NOT FOLLOWING PROCEDURE
W	SA1	023232A	112778	G	PM	B13		T	1		N	T	NO 11 CHR PUMP FAILED TO START DURING SI	BUS FAILURE DUE TO OUTPUT TRANSF FAILED
W	SA1	029119A	042479	R	PM	D06		V	1		N	D	OPERATING RHR PUMP TRIPPED OFF OF LINE	INADEQUATE WORKING PROCEDURES

ALL FAULTS IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, BWR MOTOR-DR HPCI

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	SA1	0281198	050879	R	PM	D06		V	1		N	D	OPERATING RHR PUMP TRIPPED OFF OF LINE	INADEQUATE WORKING PROCEDURES
W	SA1	026013	060179	J	PM	C05		R	1		R	T	#13 COMPONENT COOLING WATER PUMP DP DEGRADING	#13 COMPONENT COLLING WATER PUMP DP DEGRA
W	SA1	0291190	063080	R	PM	C04		U	1		N	D	RHR PUMP LOST SUCTION	LOW LEVEL LIMIT WAS TOO LOW FOR RX WA LE
W	SO1	018000	042677	I	PM	B09			1		N	T	NORTH BORIC TRANFR PMP(G-9A) FAILD TO START	PMP SEIZD DUE TO ACCUMLTN OF BORIC CRYSTL
W	SO1	030728	031880	G	PM	D21			1		N	T	HIGH TEMP IND ON SOUTH CHR PUMP'S THRUST BEARING	LOOSE COUPLING CAUSED BEARING TO BE WIPED
W	SU1	002022	111072	G	PM	A19			1		U	U	EXCESSVE SEAL LEAKAGE ON "A" CHARGING PUMP	SEAL DAMAGED
W	SU1	000916	012374	R	PM	D18			1		N	T	MOTOR ON RHR PUMP 1-RH-P-1A BURST INTO FLAMES	INSUFFICIENT LUBRICATION TO LWR RAD BRNG
W	SU1	010373	051274	I	PM	D18			1		N	T	BORIC ACID TRANSFER PUMP MOTOR FAILED	GREASE ON STAT WNDGS CAUSED INSUL FAILURE
W	SU1	017137	020877	J	PM	D21			1		U	T	CHRG WTR PMP 1-CC-P-2A HAD TRIPPED ON THERMAL OVLD	MTR BRNGS ABRADED
W	SU1	022641	100978	J	PM	D21			1		N	T	CHR PUMP COMP COOLING WATER PUMP TRIPPED ON OL	MOTOR BEARINGS FAILED DUE TOO CORROSION
W	SU1	030258	012380	I	PM	D02			1		N	D	FLOW WAS LOST FROM "A" BORIC ACID TRANSFER PUMP	SHAFT BROKE DUE TO PREVIOUS ASSEMBLY
W	SU2	013593	101575	I	PM	D18			1		N	T	"0" BORIC ACID TRANSFER PUMP MOTOR FAILED	BORIC ACID IN STATOR WINDINGS
W	SU2	017055	011877	I	PM	D15			1		N	U	BORIC ACID TRANSFER PUMP 1-CH-P-2D FAILED	MOTOR-TO-PUMP COUPLING WAS BROKEN
W	SU2	019742	111377	J	PM	B07			1		N	T	CHRG PMP COMP COOLING PMP 2B INOPERATIVE	NORMAL WEAR, PUMP REBUILT
W	SU2	020813	030178	I	PM	D21			1		N	T	BORIC ACID TRANS PMP 1-CH-P-2 TRIPD ON THERML OVRL	OUTBOARD BRNG FAILING
W	TR1	014067A	012576	J	PM	B13		T	2		T	D	COMP COOLING WTR PMPS DID NOT START AUTOMATICALLY	SEQ CONT RATED AT TOO HI AMPACITY
W	TR1	014067B	012576	G	PM	B13		T	1		T	D	B TRAIN CHARGING PUMP(S) DID NOT START	SEQ CONT RATED AT TOO HI AMPACITY
W	TR1	014566	031276	R	PM	D13		S	1		T	D	OPERATING RHR PUMP LOST POWER	CKT SWITCHER SUPP ESF BUS INADV OPENED
W	TR1	018168C	052877	R	PM	B13		T	1		T	D	B RHR PUMP DID NOT START - AUTOMATIC	SEQUENCER CONTACTS OPER WITH TOO LOW CRNT
W	TR1	018452	070177	G	PM	D14			1		N	U	SOUTH CENTRFGL CHRG PMP ROTOR FAILD	DETAILD ANALYSIS UNDERWAY
W	TR1	018905	072877	J	PM	B00		T	1		T	U	B COMP COOLING WTR PUMP FAILED TO START - AUTO	EXACT CAUSE UNKNOWN-REPLACED ALL SEQNCRS
W	TU3	000345	031973	J	PM	B13		S	1		T	D	3A COMP COOLING WATER PUMP FAILED TO START - AUTO	EMER LOAD SEQNCR RELAY CONT MALFUNCTIONED
W	TU3	014880	021976	G	PM	A16		R	1		N	U	WATER LEAKING FROM 3A CHARGNG PMP DURNG NORMAL OPS	CRACK IN CASING BETWEEN VALVCHMBR/STUFN B
W	TU3	016258	101576	G	PM	B21			1		N	T	"3B" CHRG PMP OOS DUE TO DAMAGE TO CONNECTING ROD	INSUFCNT LUBRICTN TO CONN ROD BEARINGS
W	TU3	021010	031578	G	PM	C11		R	1		M	T	"3A" CHRG PMP HAD CRACKD PMP CASING	HI CYCLIC STRESSES

ALL FAULTS IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, BWR MOTOR-DR HPCI

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W	TU3	026562	070179	G	PM	A19			1		N	T	3B CHARGING PUMP REMOVED FROM SERVICE	FAILED PRIMARY AND SECONDARY PACKING
W	TU4	018127	041577	I	PM	B09	R		1		N	T	UNITS 3 AND 4 OPERTNG ONLY 2 BORIC AC TRANFR OPRAL	THRUST IMBALNCE DUE TO CRYSTAL BLOCKAGE
W	TU4	025305	012579	I	PM	D02	T		1		N	T	4A BORIC ACID TRANSFER PUMP TRIPPED ON OVERLOAD	INSULATION NOT REINSTALLED,SOLIDIFICATION
W	TU4	027106	081579	G	PM	A19			1		N	T	4A CHARGING PUMP REMOVED FROM SERVICE	SEAL FAILED
W	TU4	027242	082979	I	PM	D11	T		1		N	T	4A BORIC ACID TRANSFER PUMP TRIPPED ON OVERLOAD	SOLIDIFCATION OF BORON IN RECIRC LINE
W	TU4	027241	083079	I	PM	B13	S		1		N	T	4B BORIC ACID TRANSFER PUMP FAILED TO START	MALFUNCTION OF LINE STARTED,DIRTY CONTACT
W	TU4	027239	091179	G	PM	A19	R		1		N	T	4C CHARGING PUMP REMOVED FROM SERVICE	FAILED SEAL
W	ZI1	000317	091073	G	PM	B13	S		1		N	T	THE 1B CHARGING PUMP WAS INOPERABLE-DID NOT START	FEEDER BRKR BRUSHHOLDER MISSING-VIBRATION
G	BF1	010171*	051374	R	PM	D02	U		2		T	D	RHR PMPS TRIPPD DUE TO ISOLATION VALVES CLOSING	FAULTY RELAYS FOR FCV74-47 AND FCV74-77
G	BR1	016856	010577	R	PM	B00			1		T	U	1A RHR FAILD TO START--MANUAL START FAILD ALSO	NO CAUSE DETERMINED
G	BR1	0181674	060177	R	PM	B13	S		1		T	D	1A RHR DID NOT START ON AUTO-SIGNAL	STICKY CONTACTOR ON CONTROL SWITCH
G	BR1	0181678	061877	R	PM	D01	S		1		T	D	2A RHR TRIPPD DUE TO OPERATOR HITTING SWITCH	ACCIDENTAL BUMPING OF CONTROL ROOM SWITCH
G	BR2	025639*	040479	R	PM	B13	U		2		T	T	RHR PUMPS 2B AND 2D WOULD NOT START FROM RTGB	POOR CONNECTIONS ON FUSES & FUSE BOX
G	CO1	011261	121374	J	PM	D18	R		1		N	T	1B CCW PMP MOTOR EXPERIENCD INSULATION FAULT-STATR	STATOR WINDNGS MIN. CLEARANCE;TEND TO SAG
G	CO1	013063	070275	J	PM	D18	R		1		N	T	1A CCW INSULATION BREAK IN STATOR	COOL. FINS HIT WINDINGS (SAGGING)
G	CO1	015715	081676	J	PM	D21	R		1		N	T	REC PUMP "A" MOTOR MAKING NOISE BEARINGS FAILED	SER.NO.P4296075,75HP.,480VAC
G	CO1	017068	011077	J	PM	D21	R		1		N	T	REC PUM MOTOR "A" NOISY BEARINGS RUNNING ROUGH	BEARINGS REPLACED
G	DA1	012797	042375	R	PM	B13	S		1		T	D	RHR PMP 2298 FAILD TO START	LOGIC RELAY E11-K708 DID NOT TRIP AS REQ.
G	EN1	014782	040976	R	PM	D02	S		1		N	D	RHR PUMP E11-C002C TRIPPED DURING FUNCTIONAL TEST	PUMP WAS WIRED INCORRECTLY
G	EN1	026419	072579	R	PM	A19			1		N	T	1C RHR PUMP HAD EXCESSIVE LEAK	MECHANICAL SEAL FAILURE
G	EN2	030834	041580	R	PM	B13	S		1		T	U	"D" RHR PUMP FAILED TO START ON LOCA SIGNAL	WIRE MISSING FROM TERMINAL NO.7 ON RELAY
G	FP1	011055	121274	R	PM	B18	S		1		T	D	RHR PMP 10P-3D FAILD TO START;REPLACED FAULTY BKR	BKR DC CHARGIN MOTOR BURNED OUT
G	MI1	001051	032173	H	PM	D21			1		N	U	COND BOOSTR "A" PUMP INBOARD BRNG FAILED	CAUSE NOT INDICATED
G	MI1	0101594	051774	H	PM	D19	R		1		N	U	FWCI COND BOOSTR "A" PUMP SEAL FAILED, SYS INOPERB	ING-RAND TYPE 10SH RECURING BRNG FAILR
G	MI1	0101598	051774	H	PM	B21	R		1		N	U	FWCI COND BOOSTR "B" PUMP BRNG FAILED, SYS INOPERB	BRNG FAILURE ON ING-RAND TYPE 10SH

ALL FAULTS IN ALTERNATING PUMPS: CCW, RHR, PWR CVC AND BOR ACID TR, PWR MOTOR-DR HPCI

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	NM1	012284	021275	H	PM	B13		T	1		N	D	12 FEEDWATER PUMP FAILED TO START (HPCI COMPONENT)	LNKGE BET BOURDON TUBE AND SWITCH DISC(NN
G	NM1	013416	091375	H	PM	B13		T	1		N	T	12 FEEDWATER PUMP FAILED TO START (HPCI COMPONENT)	OIL PMP MTR BRKR HAD LOOSE FUSE HOLDER
G	NM1	014245	021576	H	PM	D13		T	1		U	D	LOSS OF #12 FEEDWATER PUMP (HPCI COMPONENT)	LNKGE BET BOURDON TUBE AND SWITCH DISC(NN
G	NM1	015624	080976	H	PM	B13		T	1		N	D	11 FEEDWATER PUMP FAILED TO START (HPCI COMPONENT)	AGASTAT FAILED TO FUNCTION PROPERLY
G	NM1	017284	102576	H	PM	A19			1		N	T	#12 FEED PMP TAKEN OUT OF SERVICE LEAKY SEAL STRNR	LEAKS IN SEAL STRAINR AND GEAR BOX
G	NM1	017431	040477	R	PM	D06		U	1		N	U	WHILE LOWRNG R/X H2O LEVEL FOR MAINTNCE ON VESSEL	SHUTDWN COOLNG PMP TRPPD DUE TO LOW SUCT
G	NM1	020253	012078	H	PM	B13		T	1		N	D	LOST POWER TO 11 FEEDWATER PUMP AFTER LOSS OF PWR	RESERVE PWR BRKR FAILED TO CLOSE
G	NM1	032570	082280	H	PM	A07			1		N	T	#11 REACTOR FEEDPUMP HAD EXCESS SEAL H2O LEAKAGE	NORMAL WEAR TO SEAL
G	OC1	013830A	121275	H	PM	D03		S	1		T	D	FEEDWATER PUMP TRIPPD DURING LOAD TEST OF BATTERY	PERSONNEL ERROR FOLLOWING PROCEDURES
G	OC1	025825A	050279	H	PM	B00			1		N	U	A FEED PUMP DID NOT OPERATE AFTER SCRAM	CAUSE NOT STATED
G	OC1	025825B	050279	H	PM	B13		U	2		N	D	B&C FEED PUMPS DID NOT OPERATE AFTER SCRAM	BUS DE-ENERGIZED
G	PB3	010672	091874	R	PM	D18			1		N	U	"B" RHR PUMP MOTOR EXPERIENCED SHORT TO GROUND	RANDOM INSULATION FAILURE
G	PB3	027446	102279	R	PM	D18			1		N	T	3A RHR PUMP TRIPPED WHILE PROVIDING S/D COOLING	MOTOR FAN EXPERIENCED FATIGUE FAILURE
G	PI1	002247	100772	J	PM	D13		U	1		U	D	POWER CTR OVERCURRENT TRIP - LOSS OF CCW PUMP	LOADED PC SIMULTANEOUSLY VS SEQUENTIALLY
G	PI1	001043	041173	J	PM	D13		T	1		U	D	RBCCW PUMP TRIPPED BY 480V MOTOR CONTROLLER	OVERLOAD RELAYS NOT FUNCTIONING PROPERLY
G	PI1	000044	091173	J	PM	D13		T	1		N	D	RBCCW PUMP 202-C TRIPPED BY OVLD RELAY IN MTR CONT	THERMAL HTR IN CONT NOT HI ENOUGH AMPRAGE
G	PI1	000971*	032074	J	PM	B13		S	2		T	D	"B" RBCCW PUMPS DID NOT AUTO START	PRESS SW MALFUNCTION-MICRO SW OUT OF ADJ
G	PI1	018410	032377	J	PM	D13		T	1		U	D	"E" RBCCW PUMP INOPERABLE - BKR TRIPPED ON OVLD	OVERHEATING OF BLOCK TYPE OVLD RELAY

PWR Auxiliary Feedwater Pumps

The auxiliary feedwater systems contain both turbine-driven pumps and motor-driven pumps. There is also a diesel-driven pump at Trojan. The individual fault rates are estimated separately for the three kinds of pumps. Therefore, estimates of λ, r_1, and β must be given separately for each of the three kinds of pumps. Common cause shocks, on the other hand, are assumed to affect all three kinds of pumps with equal likelihood. There are not enough data to show evidence contradicting this assumption. Therefore estimates of p, λ_+, ω, μ, r_2, and r_3 are given once for the entire system.

Because turbine-driven pumps cannot operate during shutdown, the exposure times used are critical hours. For the motor-driven pumps, seven of the 35 LERs seem to report events that occurred during shutdown. Therefore, the use of critical hours, rather than calendar hours, is somewhat conservative.

Each set of rates takes two pages. Rates are estimated for:

1. Failure to start, based on all faults

2. Failure to start, based on failures only

3. Failure to operate after starting, based on all faults

4. Failure to operate after starting, based on failures only.

The individual fault rate, λ, for turbine-driven pumps is shown below. Each rate is shown as a triple (lower bound, mean, upper bound). On the left are the estimated rates based on all the data. These numbers are taken directly from the four sets of estimates printed by the computer, printed on the following pages. On the right are the estimated rates based on all the data except that from Arkansas 2.

Based on all data	Excluding Arkansas 2
(3.5E-8, 5.1E-5, 2.2E-4)	(6.2E-8, 4.2E-5, 1.7E-4)
(1.1E-7, 2.1E-5, 7.9E-5)	(8.4E-8, 2.0E-5, 7.6E-4)
(4.3E-8, 4.5E-5, 1.9E-4)	(4.6E-7, 2.9E-5, 1.0E-4)
(3.0E-9, 3.7E-5, 1.7E-4)	(7.3E-8, 2.3E-5, 8.8E-5)

If it is felt that the data from Arkansas 2 should not be used, then λ for turbine-drive pumps should be reduced as shown, and r_1, should be reduced correspondingly.

Be sure to read the Application section in the main body of this report. The following computer printouts give the estimates and summaries of the relevant data.

PWR AUXILIARY FEEDWATER PUMPS
FAILURE TO START
ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS
RATES ARE PER CRITICAL HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.286, .478, .665)
$LAMBDA_+$ = (4.1E-06, 7.4E-06, 1.2E-05)
OMEGA = (1.3E-07, 3.3E-07, 1.2E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SET OF K COMPONENTS R2	R3
1	(7.9E-06, 1.7E-05, 3.0E-05)		
2	(5.5E-06, 1.1E-05, 1.8E-05)	(1.1E-06, 2.7E-06, 4.9E-06)	
3	(4.8E-06, 9.0E-06, 1.5E-05)	(9.0E-07, 2.4E-06, 4.4E-06)	(2.8E-07, 1.4E-05, 3.0E-06)
OVERALL	(4.8E-06, 1.1E-05, 3.0E-05)	(9.0E-07, 2.7E-06, 4.9E-06)	(2.8E-07, 1.4E-06, 3.0E-06)

INDIVIDUAL RATE BASED ON MOTOR-DRIVEN PUMPS ONLY
LAMBDA = (1.8E-07, 1.3E-05, 4.4E-05)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(6.5E-06, 2.1E-05, 5.2E-05)	
2	(4.6E-06, 1.8E-05, 5.0E-05)	(.042, .204, .533)
3	(4.0E-06, 1.7E-05, 4.9E-05)	(.040, .191, .487)
OVERALL	(4.0E-06, 1.8E-05, 5.2E-05)	(.040, .204, .533)

INDIVIDUAL RATE BASED ON TURBINE-DRIVEN PUMPS ONLY

LAMBDA = (3.5E-08, 5.1E-05, 2.2E-04)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(6.4E-06, 5.9E-05, 2.3E-04)	
2	(4.4E-06, 5.6E-05, 2.3E-04)	(.010, .113, .546)
3	(3.9E-06, 5.5E-05, 2.3E-04)	(.009, .102, .500)
OVERALL	(3.8E-06, 5.6E-05, 2.3E-04)	(.009, .113, .546)

INDIVIDUAL RATE BASED ON DIESEL-DRIVEN PUMP ONLY

LAMBDA = (1.7E-04, 3.4E-04, 5.7E-04)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(1.7E-04, 3.5E-04, 5.8E-04)	
2	(1.7E-04, 3.5E-04, 5.7E-04)	(.003, .008, .019)
3	(1.7E-04, 3.5E-04, 5.7E-04)	(.003, .007, .016)
OVERALL	(1.7E-04, 3.5E-04, 5.8E-04)	(.003, .008, .019)

PWR AUXILIARY FEEDWATER PUMPS

FAILURE TO START

FAILURES ONLY, EXCLUDING COMMAND FAULTS

RATES ARE PER CRITICAL HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.097, .414, .769)

LAMBDA = (7.1E-07, 2.3E-06, 4.6E-06)

OMEGA = (1.3E-09, 3.3E-07, 1.2E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SET OF K COMPONENTS R2	R3
1	(1.5E-06, 1.0E-05, 2.8E-05)		
2	(1.0E-06, 5.8E-06, 1.5E-05)	(1.1E-07, 9.7E-07, 2.4E-06)	
3	(9.1E-07, 4.4E-06, 1.1E-05)	(7.5E-08, 8.9E-07, 2.3E-06)	(1.7E-08, 6.4E-07, 1.9E-06)
OVERALL	(9.1E-07, 5.8E-06, 2.8E-05)	(7.5E-08, 9.7E-07, 2.4E-06)	(1.7E-08, 6.4E-07, 1.9E-06)

INDIVIDUAL RATE BASED ON MOTOR-DRIVEN PUMPS ONLY

LAMBDA = (1.9E-06, 3.9E-06, 6.5E-06)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(3.7E-06, 6.5E-06, 1.0E-05)	
2	(3.2E-06, 5.7E-06, 8.8E-06)	(.022, .148, .373)
3	(3.0E-06, 5.5E-06, 8.5E-06)	(.026, .136, .318)
OVERALL	(3.0E-06, 5.7E-06, 1.0E-05)	(.022, .148, .373)

INDIVIDUAL RATE BASED ON TURBINE-DRIVEN PUMPS ONLY

LAMBDA = (1.1E-07, 2.1E-05, 7.9E-05)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(2.1E-06, 2.4E-05, 8.2E-05)	
2	(1.6E-06, 2.3E-05, 8.1E-05)	(.004, .066, .508)
3	(1.4E-06, 2.2E-05, 8.1E-05)	(.005, .059, .469)
OVERALL	(1.4E-06, 2.3E-05, 8.2E-05)	(.004, .066, .508)

INDIVIDUAL RATE BASED ON DIESEL-DRIVEN PUMP ONLY

LAMBDA = (8.0E-06, 6.8E-05, 1.8E-04)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(1.1E-05, 7.1E-05, 1.8E-04)	
2	(9.8E-06, 7.0E-05, 1.8E-04)	(.001, .014, .107)
3	(9.5E-06, 7.0E-05, 1.8E-04)	(.002, .013, .092)
OVERALL	(9.5E-06, 7.0E-05, 1.8E-04)	(.001, .014, .107)

PWR AUXILIARY FEEDWATER PUMPS

FAILURE TO OPERATE, GIVEN START

ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS

RATES ARE PER CRITICAL HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.156, .371, .600)

$LAMBDA_+$ = (3.3E-07, 5.6E-06, 1.6E-05)

OMEGA = (1.3E-09, 3.3E-07, 1.2E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SET OF K COMPONENTS R2	R3
1	(8.9E-07, 1.8E-05, 5.7E-05)		
2	(5.6E-07, 1.1E-05, 3.3E-05)	(1.6E-07, 1.6E-06, 4.7E-06)	
3	(4.6E-07, 8.5E-06, 2.6E-05)	(1.3E-07, 1.4E-06, 4.1E-06)	(4.1E-08, 8.1E-07, 2.4E-06)
OVERALL	(4.6E-07, 1.1E-05, 5.7E-05)	(1.3E-07, 1.6E-06, 4.7E-06)	(4.1E-08, 8.1E-07, 2.4E-06)

INDIVIDUAL RATE BASED ON MOTOR-DRIVEN PUMPS ONLY

LAMBDA = (5.1E-06, 9.7E-06, 1.5E-05)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(7.6E-06, 1.6E-05, 2.8E-05)	
2	(7.1E-06, 1.3E-05, 2.2E-05)	(.015, .096, .270)
3	(6.9E-06, 1.3E-05, 2.1E-05)	(.016, .100, .259)
OVERALL	(6.9E-06, 1.3E-05, 2.8E-05)	(.015, .100, .270)

INDIVIDUAL RATE BASED ON TURBINE-DRIVEN PUMPS ONLY

LAMBDA = (4.3E-08, 4.5E-05, 1.9E-04)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT Ri	BETA FACTOR
1	(2.3E-06, 5.1E-05, 2.0E-04)	
2	(1.8E-06, 4.9E-05, 2.0E-04)	(.003, .062, .453)
3	(1.5E-06, 4.8E-05, 1.9E-04)	(.003, .063, .485)
OVERALL	(1.5E-06, 4.9E-05, 2.0E-04)	(.003, .063, .485)

INDIVIDUAL RATE BASED ON DIESEL-DRIVEN PUMP ONLY

LAMBDA = (7.6E-05, 2.0E-04, 3.8E-04)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT Ri	BETA FACTOR
1	(8.1E-05, 2.1E-04, 3.9E-04)	
2	(7.9E-05, 2.1E-04, 3.9E-04)	(.001, .006, .031)
3	(7.9E-05, 2.1E-04, 3.9E-04)	(.001, .006, .029)
OVERALL	(7.9E-05, 2.1E-04, 3.9E-04)	(.001, .006, .031)

PWR AUXILIARY FEEDWATER PUMPS
FAILURE TO OPERATE, GIVEN START
FAILURES ONLY, EXCLUDING COMMAND FAULTS
RATES ARE PER CRITICAL HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.003, .199, .597)
LAMBDA = (3.7E-07, 1.6E-06, 3.6E-06)
OMEGA = (1.3E-09, 3.3E-07, 1.2E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SET OF K COMPONENTS R2	R3
1	(1.4E-06, 1.1E-03, 5.8E-04)		
2	(9.0E-07, 5.7E-04, 2.9E-04)	(1.0E-08, 5.3E-07, 1.6E-06)	
3	(7.4E-07, 3.8E-04, 1.9E-04)	(8.0E-09, 4.9E-07, 1.6E-06)	(3.0E-09, 4.0E-07, 1.4E-06)
OVERALL	(7.4E-07, 5.7E-04, 5.8E-04)	(8.0E-09, 5.3E-07, 1.6E-06)	(3.0E-09, 4.0E-07, 1.4E-06)

INDIVIDUAL RATE BASED ON MOTOR-DRIVEN PUMPS ONLY
LAMBDA = (1.0E-06, 5.0E-06, 1.1E-05)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(2.5E-06, 6.9E-06, 1.4E-05)	
2	(2.0E-06, 6.2E-06, 1.3E-05)	(.002, .064, .293)
3	(1.8E-06, 6.0E-06, 1.2E-05)	(.003, .069, .308)
OVERALL	(1.8E-06, 6.2E-06, 1.4E-05)	(.002, .069, .308)

INDIVIDUAL RATE BASED ON TURBINE-DRIVEN PUMPS ONLY

LAMBDA = (3.0E-09, 3.7E-05, 1.7E-04)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT RI	BETA FACTOR
1	(1.2E-06, 3.9E-05, 1.9E-04)	
2	(7.8E-07, 3.8E-05, 1.9E-04)	(.000, .033, .423)
3	(6.2E-07, 3.8E-05, 1.9E-04)	(.001, .034, .488)
OVERALL	(6.2E-07, 3.8E-05, 1.9E-04)	(.000, .034, .488)

INDIVIDUAL RATE BASED ON DIESEL-DRIVEN PUMP ONLY

LAMBDA = (9.0E-06, 6.8E-05, 1.8E-04)

SYSTEM SIZE M	RATE FOR SPECIFIC COMPONENT RI	BETA FACTOR
1	(9.9E-06, 7.0E-05, 1.8E-04)	
2	(9.2E-06, 6.9E-05, 1.8E-04)	(.000, .006, .065)
3	(9.0E-06, 6.9E-05, 1.8E-04)	(.000, .006, .064)
OVERALL	(9.0E-06, 6.9E-05, 1.8E-04)	(.000, .006, .065)

ALL FAILURES TO START IN PWR AUXILIARY FEEDWATER PUMPS

PLANT	CRIT. HOURS	CALEND. HOURS	POP	NUMBER OF INDIV. FAULTS FAILRS/COM FLTS	NUMBER OF NONLETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY NONLETHAL SHOCKS FAILRS/COM FLTS	NUMBER OF LETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY LETHAL SHOCKS FAILRS/COM FLTS
AR1	33594	53952	2	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
CR3	17695	32544	2	2 / 2	0 / 0	0 / 0	0 / 0	0 / 0
DB1	13042	26808	2	1 / 0	1 / 0	1 / 0	0 / 0	0 / 0
DE1	45079	65328	1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE2	37558	60384	1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE3	36816	53232	1	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RS1	29290	52968	2	1 / 1	1 / 0	1 / 0	0 / 0	0 / 0
TI1	31732	42192	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI2	3398	8784	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AR2	7068	15984	2	1 / 3	0 / 0	0 / 0	0 / 0	0 / 0
CC1	38451	52464	2	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC2	26811	33624	2	2 / 1	0 / 0	0 / 0	0 / 0	0 / 0
FC1	47570	62712	2	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MI2	30580	43464	3	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MY1	55878	69600	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PA1	38960	76704	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SL1	26228	38952	3	3 / 1	0 / 0	0 / 0	0 / 0	0 / 0
BV1	13775	38520	3	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC1	37510	49992	3	0 / 3	0 / 0	0 / 0	0 / 0	0 / 0
DC2	16911	22464	3	1 / 3	0 / 0	0 / 0	0 / 0	0 / 0
HN1	63506	76704	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	37770	64536	3	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
IP3	26443	39336	3	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	16271	27576	3	2 / 3	0 / 1	0 / 2	0 / 0	0 / 0
KE1	46125	57600	3	1 / 8	0 / 1	0 / 2	0 / 0	0 / 0
NA1	15859	21840	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA2	1724	2664	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	46464	59904	3	2 / 1	0 / 0	0 / 0	0 / 0	0 / 0
PR2	44184	50760	3	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT1	62073	76704	3	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0

PT2	64363	73104	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	58078	76704	3	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
RO2	60180	76704	3	1 / 4	0 / 0	0 / 0	0 / 0	0 / 0
SA1	16488	33360	3	1 / 2	0 / 1	0 / 1	0 / 0	0 / 0
SE1	542	2112	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	56392	76704	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	42519	72336	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	35584	66360	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TR1	21998	42048	2	1 / 10	0 / 1	0 / 2	0 / 0	0 / 0
TU3	52966	69672	3	4 / 0	1 / 0	2 / 0	0 / 0	0 / 0
TU4	46080	64056	3	0 / 0	0 / 1	0 / 3	0 / 0	0 / 0
YR1	53515	76704	1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	42451	63864	3	5 / 2	0 / 1	0 / 1	0 / 0	0 / 0
ZI2	37666	59352	3	1 / 1	0 / 1	0 / 1	0 / 0	0 / 0
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ALL	1537087	2308416	102[A]	37 / 49	3 / 8	4 / 13	0 / 0	0 / 0

A. THIS COUNTS SHARED PUMPS ONLY ONCE.

ALL FAILURES TO OPERATE, GIVEN START, IN PWR AUXILIARY FEEDWATER PUMPS

PLANT	CRIT. HOURS	CALEND. HOURS	POP	NUMBER OF INDIV. FAULTS FAILRS/COM FLTS	NUMBER OF NONLETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY NONLETHAL SHOCKS FAILRS/COM FLTS	NUMBER OF LETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY LETHAL SHOCKS FAILRS/COM FLTS
AR1	33594	53952	2	4 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CP3	17695	32544	2	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DB1	13042	26808	2	2 / 2	1 / 0	1 / 0	0 / 0	0 / 0
DE1	45079	65328	1	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE2	37558	60384	1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE3	36816	53232	1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PS1	29290	52968	2	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
TI1	31732	42192	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI2	3398	8784	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AR2	7068	15984	2	6 / 1	0 / 1	0 / 2	0 / 0	0 / 0
CC1	38451	52464	2	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC2	26811	33624	2	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FC1	47570	62712	2	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI2	30580	43464	3	5 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MY1	55879	69600	2	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PA1	38960	76704	2	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SL1	26228	38952	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BV1	13775	38520	3	2 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DC1	37510	49992	3	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC2	16811	22464	3	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	63506	76704	2	0 / 1	0 / 1	0 / 2	0 / 0	0 / 0
IP2	37770	64536	3	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP3	26443	39336	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	16271	27576	3	1 / 0	0 / 1	0 / 1	0 / 0	0 / 0
KE1	46125	57600	3	0 / 3	0 / 0	0 / 0	0 / 0	0 / 0
NA1	15859	21840	3	5 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA2	1724	2664	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	45464	59904	3	0 / 1	0 / 1	0 / 1	0 / 0	0 / 0
PR2	44184	50760	3	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PT1	62073	76704	3	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0

PT2	64363	73104	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	58078	76704	3	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0
RO2	60180	76704	3	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
SA1	16488	33360	3	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
SE1	542	2112	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	56392	76704	2	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	42519	72336	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	35584	66360	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TR1	21998	42048	2	1 / 4	0 / 0	0 / 0	0 / 0	0 / 0
TU3	52966	69672	3	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU4	46080	64056	3	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
YR1	53515	76704	1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	42451	63864	3	2 / 1	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	37666	59352	3	0 / 0	1 / 1	1 / 1	0 / 0	0 / 0
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ALL	1537087	2308416	102[A]	43 / 22	2 / 6	2 / 9	0 / 0	0 / 0

A. THIS COUNTS SHARED PUMPS ONLY ONCE.

ALL FAULTS IN PWR AUXILIARY FEEDWATER PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
B	AR1	026244	061679	B	PM	D02			1	N	D		EMERGENCY FEED WATER PUMP P7B DEVELOPED A HOT BEAR	FAULTY INSTALLATION DURING PREV MAINTEN.
B	AR1	026491	062179	B	PT	B01	U		1	N	D		EFW PUMP P7A KEPT TRIPPING ON OVERSPEED	WATER IN STEAM LINES DUE TO TRAPS ISOLATE
B	AR1	027885	120679	B	PT	C13			1	T	T		EFW PUMP P7A DID NOT DEVELOPE PROPER DELTA PRESS.	LOOSE LOCK NUT ON SPEED GOVENOR
B	AR1	031606	062480	B	PT	D00			1	N	U		STEAM DRIVEN EFP STARTED THEN TRIPPED ON OVERSPEED	SPURIOUS-CAUSE UNKNOWN
B	AR1	031817	070680	B	PT	D02			1	T	D		EMERGENCY FEEDWATER PUMP TRIPPED ON OVERSPEED	BROKEN STUD BOLTS ON GOV STEAM VALVE
B	CR3	017323	030177	B	PT	B04	R		1	N	D		EFWP TRIPPD ON OVERSPEED WHILE START ON MAIN STEAM	SLOW GOVNR RESPONSE ON REMOTE START
B	CR3	017657	041677	B	PT	B04	R		1	T	D		EFWP TRIPPD WHILE ATTEMPTN TO START ON MAIN STEAM	NEW GOVNR SLOW RESPONSE WITH MAIN STEAM
B	CR3	018288	060277	B	PT	B04	T		1	T	D		EFP-2 OVERSPEED TRIP ON INITIAL START	WATER IN STEAM SUPPLY PRVNTD THROTL CLOSN
B	CR3	018245	061677	B	PT	D21	R		1	N	U		STM DRIVEN EFWP (EFP-2) IN RECIRC MODE, WAS S/D	FAILURE OF THE OUTBOARD PUMP BEARING
B	CR3	018564	071777	B	PT	B04	T		1	N	D		EFP-2 OVERSPEED TRIP ON AUTOSTART	MODIFIED DRAIN SYS. &BYPASS AROUND IN.VLV
B	CR3	019803	112277	B	PT	D21	R		1	N	D		STM DRIVEN EFWP (EFP-2) TRPD AFTR RNNG APPX 10 MIN	INBD,OTBD BRNG FLR,ERRNEOUS SITEGLS LEVEL
B	DB1	019426	101677	B	PT	D04	B		1	T	D		GOVNR CLOSED ON AFP 1-2	VIBRATION CAUSING GOVNR TO CLOSE-DESIGN
B	DB1	019531	110877	B	PT	B04	B		1	N	D		GOVNR VALVE CLOSED DUE TO SURGING VIBRATIONS	NO FORCE TO HOLD GOVNR OPEN--MOD. REQUSTD
B	DB1	019940	121177	B	PT	B13	R		1	T	D		CONTROL OF AFP TURBINE LOST CONTROL AFPT 1-1	MECHANICAL BINDING OF GOVNR
B	DB1	020218	122877	B	PT	C04	T		1	T	D		AFPT 1-2 SPEED CONTROL LOST;WILL MODIFY RELAYS	FAILD RELAYS IN CONTROL CKT.;MODIFIED DSN
B	DB1	020271	010678	B	PT	C04	T		1	N	D		AFPT 1-1 LOSS OF SPEED CONTROL; RELAY FAILURES	SPEED CONT. CKT. MODIFIED--UPGRADED RELAY
B	DB1	027420	102279	B	PT	D18			1	T	T		AUX FEED PUMP TURBINE BEARING HAD NO LUB OIL	LOOSE SIGHT GLASS
B	DB1	030051	010380	B	PT	C13	R		1	T	T		AUX FEED PUMP DECLARED INOPERABLE (NO. 1-1)	BURR ON HIGH SPEED STOP PIN,MISADJ CLUTCH
B	DE1	031186	050980	B	PT	D09			1	T	T		EFW PUMP DECLARED INOP DUE TO NOISE FROM BEARING	BEARING FAILED DUE TO WATER IN OIL
B	DE3	012877	043075	B	PT	B02			1	T	D		EMERGENCY FEED PMP INOPRBL DUE TO TIGHT PACKNG GLN	PERSONL DID NOT VERIFY OPRBLTY AFTR MNTNC
B	RS1	011151	103074	B	PM	B01	C		1	N	D		AUX PMP SEAL RINGS FROZN TO BUSHNGS AND BSHN TO SH	OPERATR FAILD TO OPEN SUCTN VALV TO FEED
B	RS1	013184	051975	B	PM	D13	S		1	T	T		MOTOR FOR AUX FEED PUMP P-318 TRIPPED OFF LINE	LOOSE LOCKNUT ON OVERCURRENT DELAY RELAY
B	RS1	017233	021877	B	PT	U03	S		1	N	D		STEAM DRIVE TO AUX. FEED P318 TRIPPD P319 005	OPERATR FAILD TO RESET TRIP WHEN P318 IST
B	RS1	031779	071280	B	PT	B00			1	T	U		AUX FEED PUMP P-318 FAILED TO START	CAUSE UNKNOWN
C	AR2	026488	071979	B	PT	B04	T		1	N	D		EFW PUMP 2P7A TRIPPED ON OVERSPEED	MOISTURE IN STEAM LINE,NO TRAPS INSTALLED

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C	AR2	026913	081879	B	PT	B13		R	1		N	T	EFW PUMP 2P7A TRIPPED ON OVERSPEED	STICKING LINKAGE ON GOVENOR
C	AR2	027125	092379	B	PT	B04		T	1		N	T	EFW PUMP 2P7A TRIPPED ON OVERSPEED,MOISTURE IN SL	TRAPS NOT REMOVING MOISTURE IN STEAM LINE
C	AR2	028076	123079	B	PT	B04		T	1		N	T	EFW PUMP 2P7A TRIPPED ON OVERSPEED	STEAM TRAP ISOLATED,MOISTURE IN STEAM LIN
C	AR2	031023A	040780	B	PM	C11		U	1		N	D	BOTH TRAINS OF EFW PUMPS CAVITATED AFTER LOSS OF P	FORCED FLOW STOPPED IN FW SYS OH WATER
C	AR2	031023B	040780	B	PT	C11		U	1		N	D	BOTH TRAINS OF EFW PUMPS CAVITATED AFTER LOSS OF P	FORCED FLOW STOPPED IN FW SYS OH WATER
C	AR2	031376	050680	B	PT	D13		R	1		T	T	EMERGENCY FEED PUMP KEPT TRIPPING ON OVERSPEED	MISADJUSTMENTS ON GOVENOR
C	AR2	031381	052080	B	PT	D00		R	1		N	U	EMERGENCY FEEDWATER PUMP TRIPPED ON OVERSPEED,2P7A	UNKNOWN CAUSE
C	AR2	031671	061080	B	PT	C02	S		1		N	D	EMER FW PUMP 2P7A WOULD NOT EXCEED 1000 RPM	INCORRECT WIRING ON RAMP GEN AN EGM GOV.
C	AR2	031674	062780	B	PT	D00		R	1		N	U	EMERGENCY FEEDWATER PUMP TRIPPED ON OVERSPEED	UNKNOWN CAUSE,PUMP NO.2P7A
C	AR2	032094A	071780	B	PT	D04		R	1		T	D	EMERGENCY FEEDWATER PUMP 2P7A TRIPPED ON OVERSPEED	BELIEVED TO BE DESIGN RELATED
C	AR2	032094B	080480	B	PT	D04		R	1		U	T	EMERGENCY FEED PUMP 2P7A TRIPPED ON OVERSPEED	BELIEVED TO BE DESIGN RELATED
C	AR2	032094C	082980	B	PT	D04		R	1		U	T	EMERGENCY FEED PUMP 2P7A TRIPPED ON OVERSPEED	BELIEVED TO BE DESIGN RELATED
C	CC1	014753	050576	B	PT	D05			1		N	D	#12 AUX FD PMP S/D FOR REPAIR OF THTL TRIP LATCH	TAPPET NUT INCORRECTLY SIZED PER PLANS
C	CC1	023310	110378	B	PT	B13			1		T	D	11 AUX FEED PUMP DECLARED INOPERABLE	THROTTLE VALVE STUCK SHUT AFTER TEST TRIP
C	CC2	017456	031477	B	PT	U16	S		1		U	U	#21 AUX FEED PUMP REMOVED FROM SERVICE	REPAIR LEAK ON SERVICE WATER SUPPLY LINE
C	CC2	019692	111477	B	PT	B09			1		N	T	21 AFW LOW PRESS BRNG TEMP ALARM--WTR IN CASING	RUST FROM TURBINE CASING CAUSD FAILURE
C	CC2	019691	111677	B	PT	D13			1		N	U	#21 AFW PLACED OOS BINDING GOVERNOR CONTROL KNOB	BENT PIN ON MAN. SPEED SETTING KNOB
C	CC2	025180	012779	B	PT	B13	R		1		T	T	THROTTLE VLV FOR #22 AUX FEED PUMP WOULD NOT RESET	ACME THREAD OF TRAVELING NUT DISENGAGED
C	FC1	000479	101073	B	PT	B13	S		1		T	D	AFPT FW-10 FAILD TO START DURING TEST	BACKPRESSURE TRIP DEVICE MALFUNCTIONED
C	MI2	018735	070377	B	PM	U09	R		1		N	T	H20 IN "B" AUX FEED THRUST BRNG OIL DAMAGD BRNG	H20 ENTERED BRNG ALONG PUMP SHAFT
C	MI2	018738	071277	B	PT	C13			1		T	T	STM DRIVEN AUX FD PMP FAILED TO TRIP ON OVERSPEED	HARDENED GREASE IN TRIP/THTL VLV
C	MI2	021915	061978	B	PT	C02	S		1		T	D	AUX FEED PUMP WOULD NOT GO ABOVE MIN 1400 RPM	HAND SW. ON CONTROL BOARD MISALIGNED
C	MI2	026283	061479	B	PM	D09	R		1		N	T	AUX FEED PUMP BECAME INOP DUE TO FAILED BEARING	CONTAIMINATION OF OIL BY WATER
C	MI2	030387	011880	B	PT	D03			1		T	D	AUX FEED PUMP BECAME INOP DUE TO BEARING FAILURES	PREVIOUS TEST WITH PUMP UNCOUPLED
C	MI2	030799	032180	B	PM	A19			1		N	T	AUX FEED PUMP LEAK EXCESSIVELY FROM GLAND PACKING	PACKING FAILED,NATURAL END OF LIFE

ALL FAULTS IN PWR AUXILIARY FEEDWATER PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
C	MI2	031946	071280	B	PT	D07			1	T	T	AUX FEED PUMP TRIPPED PRIOR TO OVERSPEED SETPOINT	WEAR TO EMERGENCY TAPPET NUT
C	MY1	030992	040880	B	PM	D00			1	T	U	AUX FEED PUMP P-25A REQUIRED TO BE SHUTDOWN	OIL FROM BEARING,COULD NOT BE DUPLICATED
C	PA1	002049	040272	B	PM	C21			1	N	T	FLOW FROM MTR DRVN AUX FD PUMP P-8A 50 PRCT OF NOR	HYDROSTATIC BEARING FAILED - NO RECIRC
C	SL1	016880	120876	B	PT	B13	S		1	U	D	STEAM DRIVEN AUX FEED PUMP WOULD NOT START	TRIP SOLENOID LATCH FAILED TO ENGAGE
C	SL1	019503	081177	B	PT	B00	R		1	T	U	C STEAM-DRIVEN AUX FEED PMP FAILD TO START	STARTED ON 2ND TRY ,PREVIOUS FAILR RPORTD
C	SL1	025363	020879	B	PT	B13	R		1	T	U	AUX FEED PUMP 1C FAILED TO START	TRIPPED OVERSPEED TRIP,CAUSE UNKNOWN
C	SL1	026469	061479	B	PT	B18	R		1	T	T	AUX FEED PUMP 1C FAILED TO START	STEAM INLET VALVE FAILED TO OPEN
W	BV1	015727	082576	B	PM	C04			1	T	D	3A AUX FEED PUMP VAPOR BOUND CAUSING LOSS OF DISCH	DESIGN DEF OF RECIRC LINE SIZE & ORIFICE
W	BV1	017351	031077	B	PT	B00			1	N	U	STEAM AFP FAILD TO START WHEN R/X TRIPPD 50% POWER	CAUSE UNDETERMINED
W	BV1	017561	040377	B	PT	D15			1	T	T	LOUD NOISE DEVELOPED IN TURB DRIVEN AUX FEED PUMP	LOOSE COUPLING GUARD RUBBING ON COUPLING
W	BV1	020130	121577	B	PT	C13			1	N	T	STEAM AFP GOVENR FAILD TO MAINTAIN SPEED CONSTANT	MALFUNCTIONING GOVERNOR VALVE
W	BV1	025486	030579	B	PT	B09			1	U	D	AUX FEED PUMP DECLARED INOPERABLE,TR VLV DID'NT CL	NUT AND WASHER DISCOVERED IN STEAM LINE
W	DC1	015862	090676	B	PT	B04	S		1	N	D	LIMIT SWITCHES ON LINKAGE ROTATED ON SHAFT	SET SCREWS DID NOT HOLD ARMS IN PLACE
W	DC1	016115	101376	B	PT	B13	S		1	N	D	FAILD TO START FROM CONT. ROOM;TRIP LINKAGE STICKY	PAWL THAT ENGAGES THROTTLE STOP VLVE STCK
W	DC1	021939	071478	B	PT	B13	S		1	N	T	AUX FEED PUMP FAILED TO START ON START SIGNAL	SOLENOID THAT OP. TRIP THROTTLE,BURN OUT
W	DC1	022693	100278	B	PT	C13	R		1	R	U	AUX FEED PUMP FAILED TO REACH RATED SPEED	GOVERNOR WAS REPLACED
W	DC2	022892	110678	B	PT	B13	S		1	T	T	AUX FEED PUMP FAILED TO START ON SURVEILLANCE TEST	FAILED ZEMOR DIODE IN OVERSPEED MONITOR
W	DC2	025459	030679	B	PT	D21			1	T	T	AUX FEED PUMP TAKEN OOS DUE TO A HOT BEARING	BEARING FAILED,UNKNOWN CAUSE
W	DC2	030279A	012480	B	PT	C07			1	T	T	AUX FEED PUMP BECAME INOP,THROTTLE VALVE UNLATCHED	WEAR ON TWO MATING SURFACES ON LINKAGE
W	DC2	030279B	012480	B	PT	B13	T		1	N	T	AUX FEED PUMP FAILED TO START	BURNED OUT RESET COIL ON TRIP & THROTTLE
W	DC2	030744	032180	B	PT	B13	T		1	N	T	AUX FEED PUMP TRIPPED AND T&T VALVE DIDN'T RESET	RESET SOLENOID DEFECTIVE,LINKAGE MISADJU.
W	DC2	031310	052080	B	PT	U13			1	N	U	AUX FEED PUMP TRIP THRO VALVE LINKAGE UNLATCHED	CAUSE OF UNLATCHMENT UNKN,PUMP IN STANDBY
W	HN1	015218*	070576	B	PT	C11	U	2	N	T		AUX FEED PMPS WOULD NOT DEVELOP PROPER DISCH PRESS	BOTH PUMPS VAPOR BOUND - FAULTY CHK VLV
W	HN1	025723	011879	B	PT	C11	S	1	T	D		'A' AUX FEED PUMP FAILED TO REACH RATED FLOW	OVERHEATED H2O SUPPLY TO PUMP
W	IP2	010235	052274	B	PM	P13	S	1	N	D		NO. 21 AUX FD PUMP FAILED TO START - AUTOMATIC	AUTO START CKT SWITCH HAD DIRTY CONTACTS

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W	IP2	020822	121577	B	PM	D18			1		N	T	#23 AFP OOS DUE TO SPARKING MOTOR--MOTOR REPLACED	WESTINGHOUSE ,4008HP, DWG 8610800
W	IP3	017877	041277	B	PM	B15			1		N	U	ATTEMPT TO PUT #33 AUX FEED PUMP ON-LINE UNSUCSFL	SHAFT HAD SHEARED - MOD 3HMIA-9
W	JF1	019847	120377	B	PT	B13		S	1		N	D	AFP TURBINE STARTED BUT FAILD TO REACH MAX SPEED	SIGNAL CONVERTER SSC-3405 FAILD
W	JF1	023993	032578	B	PT	B01		S	1		N	D	AFPT FAILD TO START FOLLOWING R/X TRIP	TRIP/THROTTLE VALVE FOUND SHUT
W	JF1	022633	090978	B	PT	B13			1		T	U	AUX FEED PUMP DID NOT START	TRIP THROTLE VALVE TRIPPED,UNKNOWN CAUSE
W	JF1	025438	011679	B	PT	B13			1		N	T	AUX FEEDWATER PUMP FAILED TO START AFTER RX TRIP	MINT FLOW SPRING TENSION INSUFFICIANT
W	JF1	027639	110379	B	PT	D03		U	1		T	D	AUX FEED PUMP TRIPPED ON OVERSPEED	MANUAL SPEED ADJUST LEFT MISADJUSTED
W	JF1	030322*	021480	B	PM	B04		U	2		T	D	A&B AUX FEED PUMPS FAILED TO AUTO START	INADEQUATE DESIGN CHANGE CONTROL
W	JF1	030559	021580	B	PT	D02			1		T	D	AUX FEED PUMP DECLARED INOPERABLE,HOT THRUST BEAR.	MISPOSITIONED OILER ASSEMBLY,HI OIL LEVEL
W	JF1	030560	022280	B	PT	B13		S	1		N	T	WHILE STARTING AUX FEED PUMP THE TURBINE TRIPPED	TRIPPED. OVERSPEED DUE TO LIMIT SWITCH
W	KE1	010646*	080174	B	PM	B03		U	2		T	D	TWO AFP'S DID NOT START UNTIL THIRD ATTEMPT	DID NOT ALLOW OIL PRESS TO BUILDUP
W	KE1	010928	102574	B	PM	B13		S	1		N	D	1A AFP DID NOT START AUTOMATICLY ON HI WTR LEVEL	A.O. SMITH RELAY BOUND UP MECHANICALLY
W	KE1	012113	010475	B	PM	B00			1		N	U	2A AFP FAILD TO START AFTER R/X TRIP	UNDER INVESTIGATION
W	KE1	012110	012475	B	PM	B04	T		1		N	D	1A AFP FAILD TO START ;POWER SUPPLY FAILURE	BKR OPERATING HANDLE DID NOT CONTACT
W	KE1	012399	020775	B	PM	B04	T		1		N	D	1A AFP FAILD TO START ON LO-LO SG LEVEL	BKR GUIDE BAR"POSITION" NOTCH TOO SMALL
W	KE1	013499A	101575	B	PM	B13		S	1		N	D	1A AFP FAILD TO START FOLLOWING A UNIT TRIP	DEFECTIVE W-2 SWITCHES
W	KE1	013499B	101575	B	PT	B13		S	1		N	D	1C AFP FAILED TO START FOLLOWING UNIT TRIP	DEFECTIVE WESTINGHOUSE W-2 SWITCH
W	KE1	013667*	110575	B	PM	C04		S	3		N	D	AFP 1A,1B& 1C REDUCED FLOW DUE TO STARTUP STRAINRS	PLUGGD BY RESIN BEADS FROM MAKEUP DEMIN
W	KE1	013773	120475	B	PM	B00		S	1		N	U	BKR 16201 OPENED CAUSING UNIT TRIP & INOP. 1B AFP	BKR 16201 CLOSED MANUALLY
W	KE1	014386	031276	B	PM	B13		S	1		T	D	AUX FD PUMP 1A FAILED TO START ON BLACKOUT SEQ SIG	FAULTY LUBE OIL PRESSURE SWITCH
W	KE1	016117	092776	B	PM	B13		S	1		T	D	1B AFP FAILD TO START DUE TO STICKY ACTUAT. RELAY	WORN PLUNGER SHAFT,REPLACED RELAY
W	NA1	025755	033079	B	PT	D13		R	1		N	U	AUX FEED PUMP 1-FW-P-2 TRIP THROTTLE VLV CLOSED	SIGNAL FROM OVERSPEED TRIP
W	NA1	027080	090479	B	PM	D09			1		N	T	AUX FEED PUMP BECAME INOPERABLE (1-FW-P-3)	LUBE OIL STRAINER WAS CLOGGED
W	NA1	030102	011380	B	PT	D21			1		M	T	AUX FEED PUMP TAKEN OUT OF SERVICE FOR INSPECTION	BEARING HAD WIPED,DUE TO LACK OF OIL
W	NA1	030101	011480	B	PT	D18			1		N	T	AUX FEED PUMP 1-FW-P-2 DEVELOPED LEAK IN OIL COOL.	BLOWN GASKET

ALL FAULTS IN PWR AUXILIARY FEEDWATER PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	NA1	032635	090880	B	PT	D13		R	1		N	U	AUX FEED PUMP GOVERNOR VALVE FOUND TRIPPED	GOVENOR TRIPPED ON OVERSPEED.CAUSE UNKNO.
W	PR1	010725	081374	B	PM	B13		S	1		T	C	AUX FEED PUMP 12 FAILED TO START	BKR FOR AUX LUBE OIL PUMP WAS OPENED
W	PR1	011230	121274	B	PM	C09		S	1		N	T	AUX FEED PUMP 12 DID NOT MAINTAIN NORMAL DISCH FLO	SUCTION STNR CLOGGED WITH SILT
W	PR1	012411	032775	B	PT	B09			1		N	D	TURB DRVN AUX FD PMP FAIL TO REACH ACCPT DISCH PRS	STICKY GOV CONT VLV LINKAGE - DIRTY
W	PR1	017791	050177	B	PT	B06			1		N	D	#11 TURB AUX FD PMP TRIPPD TWICE ON OVERSPEED	LOW GOVERNR OIL LEVEL REVISED PROCEDURES
W	PR1	028041	122878	B	PT	D13	U		1		T	D	NO. 11 AUX FD PUMP TRIPPED OFF-LINE AT END OF TEST	STEAM SUPPLY VALVE TRIPPED ON OVERLOAD
W	PR2	019896	111077	B	PT	B13			1		T	T	#22 TURB DRVN AUX FD PMP TRIPPED ON OVERSPEED	LOOSE LINKAGE ON GOV TO PRESS COMPENSATOR
W	PR2	027527	110279	B	PT	B13			1		T	U	#22 AUX FEED PUMP FAILED TO START	OVERSPEED TRIP VALVE FOUND TRIPPED
W	PR2	031455	052980	B	PT	D02	T		1		N	D	NO. 22 AUX FEED PUMP TRIPPED INADVERTANTLY	TECH DROPPED INST ON TRIP THROTTLE LINKAG
W	PR2	032731	091480	B	PT	D02	T		1		N	D	AUX FEED PUMP TRIP MECHANISM WAS TRIPPED	WORKMAN ACCIDENTLY BUMPED TRIP MECHANISM
W	PT1	000964A	040774	B	PM	C09		S	1		U	T	"A" MTR DRIVEN AUX FD PUMP HAD INADEQUATE FLOW	IN-LINE CONICAL STRAINER WAS PLUGGED
W	PT1	0009649	040774	B	PM	U09		S	1		U	T	"B" MTR DRIVEN AUX FD PUMP WD HAVE HAD INAD FLOW	IN-LINE CONICAL STRAINER WAS PLUGGED
W	PT1	012531	041875	B	PT	A19			1		U	U	8 GALS LOW LEVL RAD. WTR LEAKD VIA STEAM-DR AUX FD	SHAFT GLANDS LEAKD SHUT DISCHRG VALVE
W	RG1	000629*	121473	B	PM	C11	U		2		T	D	AUXILIARY FEED PUMPS A & B LOST SUCTION	AIR IN SUCTION HEADER
W	RG1	012115	010875	B	PT	B13	S		1		T	D	TURBINE-DRIVEN AUX FD PUMP FAILED TO START SUCSFLY	LO LUBE OIL PRESS REGULATOR SETTING
W	RO2	000185	070973	B	PM	B13	S		1		U	D	AFP "B" TRIPPD ON INITTAN OF MANUAL START	AFP "B" TRIPPD ON INITIAN OF MANUAL START
W	RO2	011033	111974	B	PT	D02	S		1		T	D	STEAM DRIVEN AFW PUMP TRIPPED ON OVRSPD DRNG TEST	WOODWARD GOVNR MAN STTG OUT OF ADJUSTMENT
W	RO2	013685	110275	B	PM	B13	S		1		T	T	"A"AFP FAILD TO START ON SIS;3 TARNISHED CONTACTS	HIGH HUMIDITY MAY BE FACTOR FOR TAR. CONT
W	RO2	020181	122277	B	PT	D11	S		1		T	D	AFPT TRIPPD DURIN TEST RUN; HI PUMP CASING TEMP.	STEAM LEAKAGE BACK THRU VALVE V2-14C
W	RO2	022615	041178	B	PM	B13	S		1		N	D	"B" AFP FAILED TO START UPON LOSS OF MAIN FEED PRS	WORN CKT BKR TRIP ARM
W	RO2	021317	041378	B	PM	B13	S		1		N	D	"B" AFP FAILD TO START FROM RTGB	INST. TRIP COILS SETTINGS FOUND TO BE LOW
W	RO2	026362	060479	B	PM	B18			1		N	C	"A" AFW PUMP TRIPPED SHORTLY AFTER STARTING	ROTOR BARS CRACKED IN MOTOR
W	SA1	016938	010877	B	PT	R01	U		1		N	D	#13 AUXILIARY FEEDWATER PUMP FAILED TO START	PERSONNEL ERROR - TURB WAS MANUALLY TRIPD
W	SA1	022422	082478	B	PT	B13			1		T	U	AUX FEED PUMP FAILED TO START	STEAM INLET VALVE OP SHEAR PIN WAS MISSED
W	SA1	023232C	112778	B	PM	B00	S		1		N	T	NO 12 AUX FEED PUMP FAILED TO AUTO START DURING ST	NO CAUSE GIVEN. (STARTED MANUALLY)

ALL FAULTS IN PWR AUXILIARY FEEDWATER PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	SA1	023232D	112778	B	PM	B13	S		1		N	T	NO 13 AUX FEED PUMP FAILED TO START DURING SI	OVERSPEED TRIP MISADJUSTED
W	SA1	023316	121378	B	PT	D13	S		1		N	U	NO 13 AUX FEED PUMP TRIPPED ON OVERSPEED	SPEED CONTROL FOUND SET TOO HIGH
W	SO1	027965	122679	B	PT	D21			1		T	T	AUX FEED PUMP FAILED	BEARING FAILURE CAUSED BY LACK OF LUB.
W	TR1	013977	121975	B	PD	B06	T		1		N	D	DIESEL DRIVEN AUX FD PMP FAILED TO START - MANUAL	PROCEDURES INADEQ TO ENSURE SYS START L/U
W	TR1	013976	010476	B	PD	D13	T		1		N	D	DIESEL-DRVN AUX FD PUMP TRIPPED ON OVERSPEED	FDBK SIGNAL LEAD TO GOV VIBRATED LOOSE
W	TR1	014564	010976	B	PD	B13	T		1		T	D	DIESEL AFP OVERSPED WHEN MANUALY STARTED	GOVENR GAIN INCREASD TO IMPROVE RESPONSE
W	TR1	014145A	011676	B	PD	B01	U		1		N	D	AUX FEED PUMPS FAILED TO START AUTOMATICALLY	MISLOGGING OF LIFTED LEAD IN AUTO-STA CKT
W	TR1	0141458	011676	B	PT	B01	U		1		N	D	AUX FEED PUMPS FAILED TO START AUTOMATICALLY	MISLOGGING OF LIFTED LEAD IN AUTO-STA CKT
W	TR1	014251	012376	B	PD	B13	T		1		T	D	COLD STARTS OF DIESEL DRIVEN AUX FD PMPS UNSUCCSFL	CONT CKT FOR L.O. PRESS S/D NEED REDESIGN
W	TR1	014571	032876	B	PD	B13			1		N	U	DIESEL DRIVEN AUX FD PUMP STARTED - TRIPPED, OVERSP	GOV MOD D 153-005A REP W MOD T 153-005A
W	TR1	014932	051276	B	PT	B13	T		1		N	D	STM DRIVEN AUX FD PUMP FAILED TO START	TRIP/THTL VLV NOT RESET-FAULTY IND LITE
W	TR1	016003A	090276	B	PD	D13	T		1		N	T	DIESEL-DRIVEN AUX FD PMP TRIPPED-HI HAKET WTR TEMP	TEMP SWITCH SET POINT SETTING DRIFTED LOW
W	TR1	015996	090376	B	PD	B13	S		1		N	D	DIESEL-DRIVEN AUX FEED PUMP FAILED TO AUTO-START	BLOWN FUSE IN THE AUTO-START CIRCUIT
W	TR1	0160038	090976	B	PD	D13	T		1		N	T	DIESEL-DRIVEN AUX FD PMP TRIPPED HI JAKET WTR TEMP	TEMP SWITCH SET POINT SETTING DRIFTED LOW
W	TR1	015339	100576	B	PT	D13	T		1		T	T	TURBINE-DRIVEN AUX FD PUMP TRIPPED ON OVERSPEED	FAILURE OF WOODWARD GOV SPD SENSOR CARD
W	TR1	016337	101976	B	PT	B01	S		1		N	D	TURB-DRVN AUX FD PMP FAILED TO START - AUTOMATIC	OPERATOR FAILED TO RESET TRP/THTL VALVE
W	TR1	017574	032477	B	PD	D14			1		N	T	DIESL AFP TRIPPD ON LOW L.O. PRESS	BROKEN CRANKSHAFT ON DIESEL
W	TR1	020182	121777	B	PD	B13	T		1		U	D	DSL DRVN AUX FD PUMP STARTED AND IMMED TRPD-OVRSPD	MICROSWTCH IN SPD SENSING CKT OUT OF ADJ
W	TR1	020183	121777	B	PT	B13	S		1		U	D	STEAM DRIVEN AUX FEED PUMP INOPERABLE	LIMIT SW FAILURE IN OVERSPEED TRIP CKT
W	TR1	032078	072080	B	PT	B06	S		1		U	D	AUX FEED PUMP FAILED TO START MANUALLY	POOR PROCEDURE
W	TR1	032622	090380	B	PD	B18	S		1		T	T	AUX FEED PUMP FAILED TO START	FAILED STARTING BATTERY
W	TU3	010135A	050874	B	PT	B06	C		2		T	D	DURNG START TEST A & B AUX FEED FAILD TO START	PACKING TOO TIGHT DEFECTVE PROCEDURES
W	TU3	010135C	050874	B	PT	B09			1		T	T	DURNG START TEST "C"AUX FEED FAILD TO START	FOREIGN MAT IN TURB REG VALVE/GOVERNOR
W	TU3	027583	100179	B	PT	B09	R		1		T	T	'A' AFW PUMP FAILED TO START	WATER IN PNEU CONT OF PRESSURE CONTROL VL
W	TU3	027658	110579	B	PT	B20	R		1		T	T	'A' AFW PUMP FAILED TO START	MISALIGN OF CONNECTORS ON PRESS CONT VLV

ALL FAULTS IN PWR AUXILIARY FEEDWATER PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	TU3	028094	112879	B	PT	B00		R	1	T	U	'A' AFW PUMP FAILED TO START	CAUSE UNKNOWN
W	TU3	032888	092680	B	PT	C09		R	1	N	T	'A' AUX FEED PUMP FAILED TO DELIVER REQUIRED FLOW	WATER IN PNEUMATIC CONTROLS
W	TU4	000095*	061873	B	PT	B02		U	3	N	D	AUTO START OF AUX FD PMPS DID NOT OCCUR ON SCRAM	FUSES FOR AUTO-START LOGIC CKT NOT INSTLD
W	TU4	030945	040780	B	PT	C13		S	1	T	T	"A" AUX FEEDWATER PUMP FAILED TO DELIVER REQUIRED	FLOW. CONTROL CIRCUIT OUT OF CALIBRATION
W	ZI1	010126	043074	B	PM	D04		S	1	N	D	AUX FEED PMP 1B TRIPPD AFTR 30SEC,TRIPPD 2ND TIME	PMP SUCTN LINE MODFIED TO PROVIDE VENTING
W	ZI1	012080	051474	B	PT	B00			1	T	D	AUX FEED PMP 1A FAILD TO START RESET OVERSPD TRIP	OVERSPD TRIP VALVE FOUND TO BE TRIPPD
W	ZI1	010281	060674	B	PT	D09		R	1	N	T	1A AUX FEED OVERSPD VALV TRIPPD RESET THEN STARTED	WATER HAMMER BROKE TURBIN EXHAUST HANGER
W	ZI1	010718	071174	B	PT	B02		U	1	U	D	AUX FD PUMP 1A FAILED TO START FROM CONT RM	AUX FD L.O. PUMP PWR SUPPLY BKR WAS OPEN
W	ZI1	010914	091974	B	PM	B14			1	N	U	1C AUX FEED DOES NOT START PUMP INTERNALS DAMAGED	CAUSE UNKNOWN UNDER INVESTIGATION
W	ZI1	014269	030576	B	PT	B09		R	1	N	D	1A AUX FEED PUMP FAILED TO START	TURBINE WAS WATER BOUND
W	ZI1	015367A	080876	B	PT	B00			1	N	U	1A AUX FEED TRIPPD AFTR STRTD DUE TO OVERSPD TRIP	PROBABLY STICKY GOVERNOR VALVE
W	ZI1	015367B	080876	B	PM	C09			1	N	T	1C AUX FEED FAILD TO DEVELP FULL DISHRG HEAD	PLUGGED SUCTION STRAINER
W	ZI1	020112	120377	B	PT	B13	T		1	T	D	1A AUX FD PUMP WOULD NOT START	STM FLO CONT VLV SOL STUCK IN ENERGZD POS
W	ZI1	020105	120877	B	PT	B13	T		1	T	D	1A AUX FD PUMP WOULD NOT START	STM FLO CONT VLV SOL STUCK IN ENERGZD POS
W	ZI1	027284	092579	B	PM	B00			1	N	U	FOLLOWING RX TRIP 1C AFW PUMP STARTED THEN TRIPPED	RESTARTED MANUALLY,CAUSE NOT STATED
W	ZI2	0008938	021174	B	PM	D11	B		1	U	D	AUX FD PUMP 2B HAD PREVIOUSLY FAILED	APPARENTLY DAMAGED FROM AIR BINDING
W	ZI2	000814	021574	B	PT	B11	V		1	T	D	2A AUX FEED PUMP STARTED,BUT TRIPPED ON OVERSPEED	AIR WAS ASPIRATED INTO THE PUMP
W	ZI2	000893A	021574	B	PM	C11	V		1	N	D	2C AUX FD PUMP STARTED - DISCH PRESS DID NOT RISE	AIR BINDING OF PUMP IMPELLER
W	ZI2	000881	031274	B	PM	B13	S		1	U	D	2B AUX FD PMP FAILED TO START	OIL PRESS START INTLK SW WOULD NOT CLOSE
W	ZI2	019997	120777	B	PM	B00			1	N	U	2B AUX FEED PMP FAILD TO START	NO APPARENT CAUSE FOR FAILURE

BWR Turbine-Driven HPCI and RCIC Pumps

The HPCI and RCIC pumps are turbine-driven at most BWRs. Each of these plants has one pump for each system. Since the two pumps often seem to be tested together and maintained together, they are treated in this report as a single system. The exposure times used are critical hours.

Of the failures to start, all the common cause events were command faults rather than failures. Therefore, the quantities involving p cannot be estimated for failures.

Rates are estimated for:

1. Failure to start, based on all faults

2. Failure to start, based on failures only

3. Failure to operate after starting, based on all faults

4. Failure to operate after starting, based on failures only.

Be sure to read the Application section in the main body of this report. The following computer printouts give the estimates and summaries of the relevant data.

TURBINE-DRIVEN BWR HPCI/RCIC PUMPS

FAILURE TO START

ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS

RATES ARE PER CRITICAL HOUR

TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POIN' ESTIMATE, UPPER BOUND)

LOWER AND UPPER BOUNDS FORM 90 PERCENT IN' ' /AL

P = (.001, .083, .281)

LAMBDA = (9.1E-06, 8.0E-05, 2.1E-04)

LAMBDA$_+$ = (3.5E-08, 1.8E-05, 7.1E-05)

OMEGA = (2.3E-07, 1.9E-06, 5.0E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(6.3E-07, 3.8E-02, 1.4E-02)	(1.8E-05, 9.9E-05, 2.4E-04)	
2	(3.4E-07, 1.9E-02, 6.8E-03)	(1.6E-05, 9.1E-05, 2.2E-04)	(.004, .028, .148)
OVERALL	(3.4E-07, 3.8E-02, 1.4E-02)	(1.6E-05, 9.9E-05, 2.4E-04)	(.004, .028, .148)

SYSTEM SIZE M	RATE FOR BOTH COMPONENTS R2
2	(3.3E-07, 2.7E-06, 7.4E-06)
OVERALL	(3.3E-07, 2.7E-06, 7.4E-06)

TURBINE-DRIVEN BWR HPCI/RCIC PUMPS
FAILURE TO START
FAILURES ONLY, EXCLUDING COMMAND FAULTS
RATES ARE PER CRITICAL HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

λ = (3.9E-07, 2.8E-05, 9.9E-05)
λ_+ = (2.5E-09, 6.4E-07, 2.5E-06)
ω^+ = (2.5E-09, 6.4E-07, 2.5E-06)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

BWR TURBINE-DRIVEN HPCI/RCIC PUMPS
FAILURE TO OPERATE, GIVEN START
ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS
RATES ARE PER CRITICAL HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.002, .148, .470)
LAMBDA = (1.8E-05, 8.6E-05, 1.9E-04)
LAMBDA = (2.9E-06, 7.1E-06, 1.3E-05)
OMEGA = (2.5E-09, 6.4E-07, 2.5E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(1.1E-05, 7.4E-03, 3.9E-03)	(2.6E-05, 9.3E-05, 2.0E-04)	
2	(7.2E-06, 3.7E-03, 2.0E-03)	(2.3E-05, 9.0E-05, 2.0E-04)	(.000, .011, .074)
OVERALL	(7.2E-06, 7.4E-03, 3.9E-03)	(2.3E-05, 9.3E-05, 2.0E-04)	(.000, .011, .074)

SYSTEM SIZE M	RATE FOR BOTH COMPONENTS R2
2	(2.9E-08, 1.3E-06, 3.7E-06)
OVERALL	(2.9E-08, 1.3E-06, 3.7E-06)

TURBINE-DRIVEN BWR HPCI/RCIC PUMPS
FAILURE TO OPERATE, GIVEN START
FAILURES ONLY, EXCLUDING COMMAND FAULTS
RATES ARE PER CRITICAL HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.006, .341, .863)
LAMBDA = (8.2E-06, 3.3E-05, 7.0E-05)
LAMBDA$_+$ = (2.3E-07, 1.9E-06, 5.0E-06)
OMEGA = (2.5E-07, 6.4E-07, 2.5E-06)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
1	(6.0E-07, 6.0E-04, 2.9E-04)	(1.1E-05, 3.6E-05, 7.3E-05)	
2	(4.3E-07, 3.0E-04, 1.5E-04)	(1.0E-05, 3.5E-05, 7.2E-05)	(.001, .024, .146)
OVERALL	(4.3E-07, 6.0E-04, 2.9E-04)	(1.0E-05, 3.6E-05, 7.3E-05)	(.001, .024, .145)

SYSTEM SIZE M	RATE FOR BOTH COMPONENTS R2
2	(2.5E-08, 1.1E-06, 3.4E-06)
OVERALL	(2.5E-08, 1.1E-06, 3.4E-06)

ALL FAILURES TO START IN TURBINE-DRIVEN BWR HPCI AND RCIC PUMPS

PLANT	CRIT. HOURS	CALEND. HOURS	POP	NUMBER OF INDIV. FAULTS FAILRS/COM FLTS	NUMBER OF NONLETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY NONLETHAL SHOCKS FAILRS/COM FLTS	NUMBER OF LETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY LETHAL SHOCKS FAILRS/COM FLTS
BF1	32634	62448	2	5 / 9	0 / 0	0 / 0	0 / 1	0 / 2
BF2	29788	54360	2	0 / 6	0 / 1	0 / 1	0 / 0	0 / 0
BF3	26961	36360	2	0 / 3	0 / 0	0 / 0	0 / 0	0 / 0
BR1	22445	34896	2	6 / 4	0 / 0	0 / 0	0 / 0	0 / 0
BR2	27176	48528	2	9 / 8	0 / 4	0 / 4	0 / 0	0 / 0
CO1	45502	57936	2	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DA1	35182	57216	2	1 / 2	0 / 2	0 / 2	0 / 0	0 / 0
DR2	58693	76704	1	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR3	56458	76704	1	1 / 2	0 / 0	0 / 0	0 / 0	0 / 0
EN1	39105	53064	2	1 / 5	0 / 0	0 / 0	0 / 0	0 / 0
FR2	10147	19680	2	1 / 1	0 / 1	0 / 1	0 / 0	0 / 0
FP1	33779	51490	2	0 / 6	0 / 1	0 / 1	0 / 0	0 / 0
MO1	62706	76704	2	1 / 2	0 / 1	0 / 1	0 / 0	0 / 0
PB2	40497	61728	2	2 / 7	0 / 1	0 / 1	0 / 0	0 / 0
PB3	40274	53928	2	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
PI1	48238	72696	2	1 / 2	0 / 0	0 / 0	0 / 0	0 / 0
QC1	56398	76704	2	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
QC2	56912	73920	2	3 / 3	0 / 0	0 / 0	0 / 0	0 / 0
VY1	57426	74712	2	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	777321	373920	36	35 / 63	0 / 11	0 / 11	0 / 1	0 / 2

ALL FAILURES TO OPERATE, GIVEN START, IN TURBINE-DRIVEN BWR HPCI AND RCIC PUMPS

PLANT	CRIT. HOURS	CALEND. HOURS	POP	NUMBER OF INDIV. FAULTS FAILRS/COM FLTS	NUMBER OF NONLETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY NONLETHAL SHOCKS FAILRS/COM FLTS	NUMBER OF LETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY LETHAL SHOCKS FAILRS/COM FLTS
BF1	32634	62448	2	1 / 12	0 / 0	0 / 0	0 / 0	0 / 0
BF2	29788	54360	2	1 / 5	1 / 0	1 / 0	0 / 0	0 / 0
BF3	26961	36360	2	2 / 4	0 / 0	0 / 0	0 / 0	0 / 0
BR1	22445	34896	2	4 / 3	0 / 0	0 / 0	0 / 0	0 / 0
BR2	27176	48528	2	2 / 2	0 / 1	0 / 1	0 / 0	0 / 0
CO1	45502	57936	2	2 / 7	0 / 0	0 / 0	0 / 0	0 / 0
DA1	35182	57216	2	3 / 3	0 / 1	0 / 1	0 / 0	0 / 0
DR2	58693	76704	1	2 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DR3	56458	76704	1	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
EN1	39105	53064	2	7 / 6	0 / 1	0 / 1	0 / 0	0 / 0
EN2	10147	19690	2	2 / 5	0 / 0	0 / 0	0 / 0	0 / 0
FP1	30779	51480	2	3 / 3	0 / 0	0 / 0	0 / 0	0 / 0
MO1	62706	76704	2	1 / 4	0 / 0	0 / 0	0 / 0	0 / 0
PB2	40497	61728	2	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PB3	40274	53928	2	2 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PI1	48238	72696	2	2 / 4	0 / 0	0 / 0	0 / 0	0 / 0
QC1	56399	76704	2	5 / 0	0 / 1	0 / 1	0 / 0	0 / 0
QC2	56912	73920	2	5 / 0	0 / 0	0 / 0	0 / 0	0 / 0
VY1	57426	74712	2	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	777321	373920	36	46 / 64	1 / 4	1 / 4	0 / 0	0 / 0

ALL FAULTS IN TURBINE-DRIVEN BWR HPCI AND RCIC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	BF1	000301	090473	H	PT	B13		T	1	U	D	STM SUP VLV TO HPCI TURBINE,FCV-73-16,FAILED TO OP	LIMITORQUE DRIVE MOTOR-DAMAGED GEARS
G	BF1	000368	091073	H	PT	B13		T	1	U	D	HPCI FAILED TO REACH RATED SPEED & FLO ON QK START	FLOW CONTROLLER MALFN-BAD CONNECTOR
G	BF1	000518A	111073	H	PT	U13		N	1	N	U	HPCI INOPERABLE UNTIL MANUALLY RESET	TRIP LOGIC IMPROP DESIGNED FOR LOSP
G	BF1	000518B	111073	Q	PT	U13		N	1	N	U	RCIC INOPERABLE UNTIL MANUALLY RESET	TRIP LOGIC IMPROP DESIGNED FOR LOSP
G	BF1	000521	111573	Q	PT	B13		S	1	T	D	RCIC SYS FAILED TO OPER WHEN MANUALLY INITIATED	STEAM SUPPLY VLV WOULD NOT OPEN
G	BF1	000522	111573	H	PT	B00		S	1	N	U	HPCI ISOLATED AND TRIPPED ON MANUAL INITIATION	NO APPARENT CAUSE
G	BF1	000655	122573	H	PT	C13		T	1	T	T	HPCI TURBINE FAILED TO REACH RATED SPEED & FLOW	GOVERNOR UNABLE TO PROPERLY SIGNAL CONTRL
G	BF1	000872	012674	H	PT	C13		T	1	T	D	HPCI FLOW & TURBINE SPEED UNSTABLE	DEFECTVE PARTS IN EGM CONTROL BOX
G	BF1	010018	031274	H	PT	C13		T	1	T	T	HPCI TURBINE FAILED TO REACH RATED SPEED AND FLOW	EGM BOX FAILED DUE TO DEFCTV TRANSISTOR
G	BF1	000978	041374	H	PT	C13		T	1	U	T	HPCI FAILED TO REACH RATED FLOW IN REQUIRED TIME	TWO DFCTV XSISTORS IN GOV EGM CONTROL BOX
G	BF1	010122	050574	H	PT	B00		R	1	N	U	HPCI SYSTEM ATTEMPTED TO START BUT TRIPPED	UNDETERMINED
G	BF1	010294	060974	H	PT	B13		R	1	T	D	HPCI REQD SEVERAL MANUAL START ATTEMPTS FOR OPERTN	OIL RELAY VALVE DID NOT OPEN FULLY
G	BF1	010422	062174	H	PT	B13		R	1	U	D	HPCI TURBINE FAILED TO START MANUALLY	TURB STOP VLV PILOT PISTON WAS MALFUNCTNG
G	BF1	010533	082074	Q	PT	B04		T	1	N	D	RCIC FAILED TO START AFTER A REACTOR SCRAM	CONTROL COMPONENTS OUT OF CAL-WRONG LOCTN
G	BF1	010793	091874	H	PT	B13		T	1	N	D	HPCI FAILD TO START DURIN SURVLLNCE AT 95% POWER	CONTACTS IN AUX OIL PMP CIRCUIT HUNG UP
G	BF1	010938	111574	Q	PT	B20			1	T	T	RCIC TRIPPED ON OVERSPEED DURING AUTO-INITIATION	REMOTE SERVO OUT OF ALIGNMENT W GOV LEVER
G	BF1	0159298	092176	H	PT	D18		T	1	T	T	HPCI TRIPPED DURING TESTING	LEAKING STEAM DISCHARGE LINE RUPTURE DISK
G	BF1	0159298	092176	Q	PT	B13		T	1	T	T	RCIC FAILED REQUIRED SURVEILLANCE TEST	GOVERNOR EG-R MALFUNCTIONED
G	BF1	018124	050277	Q	PT	C13		T	1	T	T	RCIC SYSTEM FAILED TO REACH RATED FLOW AND PRESS	IMPROPER SPEED REF VLTG TO EG-M CONT BOX
G	BF1	018126	050977	H	PT	B13		T	1	T	D	HPCI TURB STM SUPPLY VLV,FCV-73-16, FAILED TO OPEN	LIMITORQUE ACTUATOR,MOD SMB-2,BROKN TEETH
G	BF1	018122	051277	H	PT	B13		T	1	T	D	HPCI AUX OIL PUMP FAILD TO START	DEFECTIVE PRESS. SWITCH
G	BF1	018540	080177	Q	PT	C13		T	1	T	T	RCIC TURB DID NOT PRODUCE RATED FLOW IN REQD TIME	RAMP GEN AND SIGNAL CONVERTER OUT OF ADJ
G	BF1	018691	080877	H	PT	D13		T	1	T	T	HPCI TURBINE SPEED CONTROLLER WOULD NOT CONT TURB	POWER SUPPLY TO GOV FAILED-RESISTOR FAILD
G	BF1	027316	101079	H	PT	D04		T	1	T	D	HPCI TURBINE TRIPPED DUE TO RUPTURE DISK RUPTURE	REPLACING WITH IMPROVED RUPTURE DISK
G	BF1	027834	120379	H	PT	B13			1	T	T	HPCI STOP VALVE FAILED TO REMAIN OPEN	SPRING IN TRIP MECHANISM NOT COMPRESSED

ALL FAULTS IN TURBINE-DRIVEN BWR HPCI AND RCIC PUMPS

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G	BF1	030306	012780	H	PT	C11	T	1	U	D			HPCI PUMP TURBINE HAD CRACK ON COUP BEAR SUPP PED.	BELIEVED TO BE CAUSED BY A WATER HAMMER
G	BF1	030887	040280	Q	PT	D18	T	1	T	D			RCIC TRIPPED DUE TO A HIGH RUPTURE DISC PRESSURE	TEFLON SHEET PORTION OF DISC FAILED
G	BF1	030977	040780	H	PT	D18	T	1	T	D			HPCI PUMP TRIPPED DUE TO FAILED EXHUST RUP. DISC	TEFLON SHEET PORTION OF DISC FAILED
G	BF1	031403	060280	H	PT	D13	R	1	T	T			HPCI PUMP FAILED DUE TO INADVERTANT TRIPPING	WORN OVERSPEED TRIP PISTON
G	BF2	010491	081174	H	PT	B02	U	1	T	T			HPCI ISOLATION OCCURED DURING MANUAL HPCI START	EXHST RUPTURE DISK FLO-SOL VLV WIRED WRNG
G	BF2	010493	082374	Q	PT	C13	T	1	U	T			RCIC FAILED TO REACH RATED FLOW	TURBINE TACHOMETER CIRCUIT FAILED
G	BF2	010815	092474	H	PT	B04	T	1	N	D			HPCI SYSTEM INOPERABLE DUE TO EXHAUST LINE FLOODED	SUMP FLOODING CAUSD HOTWELL PUMP FAILURE
G	BF2	010816	100774	H	PT	B04	T	1	N	D			FLOODED SYS. DUE TO LEAKING GLAND SEAL COND. GASKT	FLOODED TURB. SUMP & HOTWELL PUMP
G	BF2	010996	110474	K	PT	B04	T	1	N	D			HPCI INOPERABLE DUE TO FLOODED GLAND STEAM CONDEN.	RUPTURED GASKETS ON CONDENSER
G	BF2	011097	120374	H	PT	B04	T	1	N	D			HPCI AUTO-ISOLATED AFTER AUTO-ACTUATION	NO PROVISION FOR EXHAUST LINE DRAINAGE
G	BF2	012083	010775	Q	PT	B13	T	1	T	T			RCIC SYSTEM FAILED TO OPERATE DURING A TEST	RESISTOR FAILED IN PWR SUP TO EGM CONTRLR
G	BF2	012082	011675	Q	PT	D13	R	1	N	T			RCIC TURBINE TRIPPED DURING NORMAL OPERATION	MECH OVRSPD EMERG TAPPET NUT HAD ROTATED
G	BF2	015936	090876	Q	PT	C13	T	1	T	T			RCIC TURBINE GOV SPEED CONTROL FAILED TO RESPOND	OPEN RESISTOR IN GOV PWR SUP ASSEMBLY
G	BF2	016807	111676	H	PT	B13	S	1	T	D			HPCI TURBINE STEAM SUP VLV,FCV-73-16,FAILED TO OPN	LIMITORQUE SMB-2 TORQUE SW GEAR PIN BROKE
G	BF2	021782	062778	H	PT	D03	C	1	T	D			DAMAGE SUBSTAINED TO HPCI PUMP AND REDUCTION GEARS	VALVE IN LUBE OIL LINE WAS NOT OPENED
G	BF2	030417	021680	H	PT	C11	S	1	M	D			HPCI PUMP TUR HAD CRACK ON COUP BEAR SUPPORT PED.	BELIEVED TO BE CAUSED BY WATER HAMMER
G	BF2	030637	031080	H	PT	D18	T	1	T	D			HPCI PUMP TRIPPED DUE TO FAILED EXH RUPTURE DISC	TEFLON SHEET PORTION OF DISC FAILED
G	BF2	032259	081280	H	PT	D18	T	1	T	D			HPCI PUMP TRIPPED DUE TO FAILED EXH RUPTURE DISC	TEFLON SHEET PORTION OF DISC FAILED
G	BF3	016055	082476	H	PT	B18	S	1	T	D			RUPTURE DISK ON STM DISCH LINE FAILED ON HPCI S/U	CHK VLV IN EXHST LINE BINDING
G	BF3	015937	082676	H	PT	B13	T	1	T	T			HPCI TURBINE CYCLED ON START UP	GROUNDED CONNECTOR ON GOV EGM BOX
G	BF3	016056	092176	H	PT	C18	S	1	T	T			HPCI SHAFT OIL PMP PESS.LOW CAUSN ERRATIC TURBINE	LEAKING UNION ON SUCTION OF OIL PUMP
G	BF3	016059	100176	Q	PT	C02	S	1	T	D			RCIC CONTROLLER FAILED TO CONTROL SPEED	BROKEN WIRE IN GOV SPEED SENSING CIRCUIT
G	BF3	018637	070577	H	PT	B13	S	1	T	D			HPCI TURBINE STM SUP VLV,FCV-73-16,FAILED TO OPEN	TORQUE SW GEAR ASSY,SMB-2,REPLACED
G	BF3	018892	083077	H	PT	C13	T	1	T	T			HPCI TURBINE SPEED CONTROLLER WOULD NOT CONT TURB	OPEN RESISTOR IN GOVERNOR POWER SUPPLY
G	BF3	021839	070678	H	PT	D13	T	1	T	D			HPCI PUMP TRIPPED DURING SURVEILLANCE TEST	FAILED RESISTOR IN POWER SUPPLY TO GOVEN.

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G	BF3	023185	112478	Q	PT	D13			1		T	T	RCIC PUMP TRIPPED ON OVERSPEED	OIL LEAK ON ELEC-GOVENOR-REGULATOR
G	BF3	031576	060980	Q	PT	D13			1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED	VOLTAGE SUPPRESSOR IN EGM BOX FAILED
G	BR1	016861	112176	H	PT	B13	S		1		T	T	HPCI STM SUPPLY VLV,E41-F001, WOULD NOT OPEN	BRUSHES IN VALVE MOTOR WERE STICKING
G	BR1	016858	120376	Q	PT	B13	S		1		T	T	RCIC STM ISOLATION VLV,E51-F007, FAILED TO OPEN	LOOSE WIRE ON VLV MOTOR OPEN CONTACTOR
G	BR1	019272	093077	Q	PT	B00	R		1		T	U	RCIC TURBINE TRIPPED ON HI EXHST PRESS DURING S/U	NO CAUSE GIVEN
G	BR1	019679	110577	H	PT	D01	S		1		T	D	HPCI TURBINE TRIP DUE OIL PMP TRIP;SHORTED MOTOR	HI WATER IN HPCI ROOM DUE TO PMPING ROOMS
G	BR1	019842A	111077	Q	PT	B00	R		1		T	U	RCIC TURBINE TRIPPED DURING MANUAL START UP	NO CAUSE FOUND
G	BR1	019842B	111177	Q	PT	B00	R		1		T	U	RCIC TURBINE TRIPPED ON HI EXST DURING MAN START	NO CAUSE FOUND
G	BR1	020614	021378	Q	PT	B00	R		1		N	U	RCIC TURBINE TRIPPED ON OVERSPEED AFTER RX SCRAM	NO CAUSE DETERMINED FOR OVERSPEED
G	BR1	021090	041278	H	PT	C01			1		T	T	TURBINE CONT. VALVE WOULD NOT OPERATE DUE TO CORRO	EXCESSVE WTR IN ROOM(OCT.77) WAS CAUSE
G	BR1	021253	042178	Q	PT	D10	S		1		T	T	RCIC TRIPPD DUE TO FALSE MECH. OVERSPEED INDICATIN	EGR ACTUATOR CORRODED;LEAKY VALVES
G	BR1	022699	101478	Q	PT	B02	S		1		T	D	RCIC TURBINE STOP VALVE WOULD NOT RESET AFTER TRIP	EXCESSIVE PAINT AND DIRT ON TRIP LEVER
G	BR1	023061	111478	H	PT	C09			1		T	T	HPCI EGR FAILED TO OPERATE PROPERLY	WATER IN HYDRAULIC FLUID CAUSED CORROSION
G	BR1	025090	010479	H	PT	C13			1		T	T	HPCI TURBINE FAILED RESPONSE TEST	GOVENOR ASSEMBLY OUT OF ADJUSTMENT
G	BR1	027037	091679	H	PT	U13	S		1		N	T	HPCI TURBINE NOTICED TO BE TRIPPED	SUCTION PRESSURE SWITCH FOUND OUT OF CAL
G	BR1	027232	092679	Q	PT	D02			1		N	D	RCIC TURBINE TRIPPED	MEN WORKING ABOVE TRIP MECHANISM
G	BR1	030195	012180	H	PT	D13	S		1		T	T	HPCI AUX LUBE OIL PUMP WOULD NOT RUN IN AUTO	LOOSE WIRE ON RTGB CONTROL SWITCH
G	BR1	030773A	032480	H	PT	B13	R		1		N	T	HPCI PUMP TRIPPED ON OVERSPEED WHILE STARTING	STROKE TIME FOR STOP VALVE WAS TO FAST
G	BR1	030773B	040280	H	PT	B13	R		1		T	T	HPCI PUMP TRIPPED ON OVERSPEED WHILE STARTING	STROKE TIME FOR STOP VALVE WAS TO FAST
G	BR2	013325	041375	Q	PT	D18	T		1		N	D	RCIC TURBINE TRIPPED DUE TO HIGH EXHAUST PRESSURE	EXHAUST LINE CHECK VALVE STUCK SHUT
G	BR2	013343	041475	H	PT	B02	U		1		T	D	HPCI TURBINE STOP VALVE V8 FAILED TO OPEN FULLY	PERSONNEL ERROR-NEEDLE VLVS IMPRPR ADJST
G	BR2	013379	041475	H	PT	B13	S		1		T	T	HPCI TURBINE SUPPLY VALVE F001 FAILED TO OPEN	VALVE MOTOR WINDINGS FAILED
G	BR2	013626	090275	H	PT	B13	S		1		T	D	HPCI STEAM ISOLATION VALVE F003 FAILED TO OPERATE	AUXILIARY RELAY PLUNGER BROKE
G	BR2	013514	100175	Q	PT	B13	R		1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013515	100375	Q	PT	B13	R		1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE

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G	BR2	013516	100475	Q	PT	B13	R		1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013517	100975	Q	PT	B13	R		1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013689	102775	Q	PT	B14	T		1		U	D	RCIC TURBINE TRIPPED BECAUSE OF HIGH EXHAUST PRESS	CHK VLV F040 JAMMED PARTIALLY CLOSED
G	BR2	013800	110375	Q	PT	B13	R		1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013702	111075	Q	PT	B13	R		1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013799	111475	Q	PT	B13	R		1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013816	111875	Q	PT	B13	S		1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	BURNED OUT XSISTORS IN GOV VLV CONTROLLER
G	BR2	014646	020476	Q	PT	B18	T		1		U	D	RCIC TURBINE TRIPPED ON HIGH EXHAUST PRESSURE	DISCHARGE CHK VLV,F040,DISC BLOCKING FLOW
G	BR2	016260	110276	Q	PT	B02	U		1		N	D	RCIC TURBINE TRIPPD ON HI EXHAUST PRESS	EXHAUST STOP-CHECK VLV NOT OPENED
G	BR2	017327	022377	Q	PT	B13	S		1		N	T	RCIC TURBINE STEAM INLET VALVE WOULD NOT OPEN	VALVE OPERATOR FOR F045 WAS BURNED UP
G	BR2	017535	040577	H	PT	B11	T		1		N	T	HPCI AUTO STARTED BUT THEN TRIPPED ON HI DELTA T	RX BLDG HEAT WAS OFF-THEREFORE HI DELTA T
G	BR2	018134	050777	Q	PT	B01	U		1		N	D	RCIC TURB. OVERSPED AFTR MANUAL START FOLLWN SCRAM	OPERATOR DIDN'T CHECK MAN. SPEED SETTING
G	BR2	018673	061477	H	PT	B11	T		1		N	T	HPCI TRIPPED ON HIGH DIFFERENTIAL TEMPERATURE ISOL	RX BLDG VENTLTN WAS ISOL-HI HPCI RM TEMP
G	BR2	019016	090477	H	PT	B13			1		N	T	HPCI FAILED TO INJECT WATER ON RX SCRAM	LOOSE FITTING IN CONT OIL LINE TO SERVO
G	BR2	020206	122777	H	PT	C13	S		1		T	T	HPCI TURBINE SPEED COULD NOT BE CONTROLLED	DEFECTIVE EGM UNIT-GROUND IN EGR ACT COIL
G	BR2	022453	092478	Q	PT	B00			1		T	U	RCIC TURBINE TRIP AND THROTTLE VALVE TRIPPED	TRIP THROTTLE COULD NOT BE RESET,UNKNOWN
G	BR2	025377	030179	H	PT	C13			1		T	T	HPCI PUMP HAD SEVERE OSCILLATIONS WHEN ACCELERATIN	SET SCREWS ON SPUR GEAR ON REF SPEED LOOS
G	BR2	026037	051879	H	PT	D13			1		T	T	HPCI PUMP TRIPPED ON OVERSPEED TOO SOON	ADJUSTING SCREW FOUND 5 TURNS OUT OF PCS.
G	BR2	032454A	090780	Q	PT	D01	U		1		T	D	RCIC TURBINE TRIPPED ON HIGH EXHUST PRESSURE	INCORRECT VALVE LINE-UP
G	BR2	032454B	090780	H	PT	U01	U		1		T	D	HPCI STOP-CHECK ALSO FOUND SHUT	PERSONNEL DIDNT VERIFY POSITN AFTER MAINT
G	CO1	010207	030874	H	PT	C13	S		1		T	U	TURBINE SPEED CONTROL PROBLEMS DURIN PUMP OPER TES	DIODE VR1 IN SPEED REF. CKT. OF AMPLIFIER
G	CO1	010296	053074	Q	PT	B13	S		1		T	T	RCIC TRIPPED ON OVERSPEED DURING STARTUP TEST	FLOW CONTROLLER DRIFTED UPWARD 4 MA
G	CO1	012814	051275	Q	PT	C13	S		1		T	D	RCIC FLOW WAS 375 VS 388 GPM FOR CORRSPNDG PRESSUR	FLOW INSTRUMENTS CALIBRATION WAS TOO LOW
G	CO1	014304	012276	Q	PT	C04	S		1		T	T	RCIC TURB. WOULD NOT RESPOND TO CONTROL INPUT	R-14 & R-15 IN PCB. ASSY FAILD FROM HEAT
G	CO1	018898	083177	H	PT	C13	S		1		N	T	HPCI TURB STARTED BUT DID NOT ACCEL OR INJECT	GOVERNOR EG-R ACTUATOR FAILED TO OPERATE

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G	CO1	019289	083177	Q	PT	C13		S	1	N	T		RCIC INITIATED ON SCRAM BUT DID NOT RAMP UP SPEED	VITAL PWR FUSE BLOWN AND CONTACTOR OOS
G	CO1	020804	011178	H	PT	D02			1	T	D		SIGNIF AMT OF WTR DISCOVD BLWING FRM HPCI CASE FLG	CASE NOT TORQD CORRECTLY BY MAINT PRSNL
G	CO1	020805	020778	H	PT	D02		S	1	T	D		TURBINE SPEED 74000RPM LED TO HPCI STEAM LINE ISO	DPIS 76&77 READING HI;SENSING LINE BACKFL
G	CO1	021061	031178	Q	PT	C13		S	1	T	T		RCIC TURBINE FAILED TO RESPOND PROPERLY	RAMP GENERATOR MISALIGNED DUE TO DRIFT
G	CO1	026930	080979	H	PT	B13			1	N	T		HPCI PUMP FAILED TO START ON AUTO START SIGNAL	TURBINE STOP VALVE OPERATOR MALFUNCTIONED
G	CO1	030855	031280	Q	PT	C09			1	M	D		RCIC TURBINE BLADING FOUND DAMAGED	IMPINGMENT OF FOREIGN OBJECT ON THE WHEEL
G	DA1	010219	060474	Q	PT	B06	U		1	T	D		RCIC FAILED TO START AUTOMATICALLY	GOV CONT CKT SET HIGHER THAN OVRSPD TRIP
G	DA1	0104244	062274	H	PT	B13		S	1	T	U		HPCI FAILED TO INJECT	HPCI STOP VALVE FAILED TO OPEN
G	DA1	0104248	062374	H	PT	B04			1	U	D		HPCI FAILED TO INJECT WITHIN REQUIRED TIME	PISTON IN MECH OVRSPD TRIP WAS UNDERSIZED
G	DA1	013576	102275	H	PT	C13		S	1	T	T		HPCI TURBINE WOULD NOT RESPOND TO SPEED CHANGE SIG	HPCI SPEED CONTROLLER RELAY MALFUNCTIONED
G	DA1	016588	122076	H	PT	B06	U		1	T	D		HPCI TURBINE TRIPPED ON FAST START WITH HI FLO IND	HI FLOW PDIS SETPOINTS WERE INCORRECT
G	DA1	019127	092177	H	PT	C06	U		1	T	D		HPCI WOULD NOT DEVELOP SUFFCNT RPM	EXCESSIVE OPENING OF L.O. THROTLE VALVES
G	DA1	019968	122077	H	PT	C02	T		1	T	D		HPCI DISCH FLOW RATE DID NOT REACH REQD FLOW	IMPROPER ADJUSTMENT OF THTL SCREWS
G	DA1	020178	122777	H	PT	C07	T		1	T	D		HPCI SYS DID NOT REACH REQD FLOW RATE OF 3000 GPM	WEAR TO TURBINE SHAFT DRIVEN OIL PUMP
G	DA1	021565	051978	H	PT	C13			1	T	T		HPCI PUMP DID NOT REACH RATED CAPACITY	THROTTLE ADJ SCREWS FOUND OUT OF ADJUST.
G	DA1	030456	030480	H	PT	C04			1	M	D		HPCI BOOSTER PUMP SLPIT RING FOUND IN MAIN HPCI P.	WRONG SET SREWS USED IN BOOSTER PUMP
G	DA1	031421	052480	H	PT	C13			1	T	T		HPCI TURBINE WOULD NOT REACH RATED SPEED	LEAKING OIL SEAL ON TURBINE STOP VALVE
G	DA1	031884	071180	Q	PT	B10	S		1	T	T		RCIC TRIP THROTTLE VALVE WOULD NOT OPEN ELECTRIC.	CORRODED CONTACTS ON MOTOR OP LIMIT SW.
G	DR2	013460	092975	H	PT	C13			1	U	T		HPCI TURBINE FAILED TO TRIP AT DESIGN COOLANT LEVL	OPEN CKT IN COIL OF TRIP THTL SOLONOID VA
G	DR2	018931	091077	H	PT	C13			1	T	D		HPCI MOTOR SPEED CHGR FAILED TO BRING TURB GT 2800	LOSS OF PIN FROM MTR SPD CHNGR AND GEAR
G	DR2	022551	093078	H	PT	D13	S		1	T	T		HPCI TRIPPED ON LOW SUCTION PRESSURE	INST DRIFT OF PRESSURE SWITCH
G	DR2	023340	010379	H	PT	B00			1	T	U		HPCI PUMP FAILED TO START	CAUSE NOT STATED
G	DR3	002298	052072	H	PT	B13	S		1	T	U		HPCI TURBINE FAILED TO START REMOTELY	BROKEN WIRE ON THE TURBINE RESET SOLONCID
G	DR3	000055	060873	H	PT	B13	S		1	U	U		HPCI STEAM SUPPLY VALVE FAILED TO OPEN COMPLETELY	STEM OF THE VALVE WAS BENT
G	DR3	000717	011774	H	PT	B18			1	T	D		HPCI CONTROL VALVES FAILED TO OPEN	BURRS ON CYLINDER WALL AND PISTON

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G	DR3	019911	121677	H	PT	C13		S	1		T	D	HPCI FLOW CONTRLLR FAILD TO CONTROL MOTOR GEAR	HPCI INOPERABLE;FAILD PWR SUPPLY IN CONVT
G	EN1	012382	011075	Q	PT	B02		S	1		N	D	RCIC TURBINE TRIPPED DURING AUTO START AFTER SCRAM	WIRING ERROR ON THE TURBINE GOVERNOR
G	EN1	012971	070575	Q	PT	C13			1		N	T	TURBINE SPEED CONTROL MALFNCTND SHAFT L.O. PUMP LO	WORN DRIVE GEARS (UPPR & LWR BUSHINGS)
G	EN1	013071	071375	Q	PT	B13	T		1		N	T	RCIC TURBINE TRIPPED ON OVERSPEED AFTER RX SCRAM	ELEC OVERSPD INST CONTAINED MALFN XSISTOR
G	EN1	013606	090675	Q	PT	B00			1		T	U	RCIC TURBINE TRIPPED ON OVERSPEED	COMPONENT FAILURE - NO PROBLEM FOUND
G	EN1	013907	111575	Q	PT	C13	R		1		N	T	RCIC MECHNCL OVERSPEED TRIP SETPOINT HIGH	RECALIBRATED MECHANICAL OVERSPEED
G	EN1	014773	022276	Q	PT	B11	T		1		N	D	RCIC TRIPPD ON MANUAL START--TRIPPD BY MECH OVRSPD	VIBRATION CAUSD VALVE TO UNLATCH ON S/U
G	EN1	014789	042276	Q	PT	C02	U		1		T	D	RCIC TURBINE SPEED WOULD NOT INCREASE	PERSONNEL CUT CABLE TO PUMP (OUR OUTAGE)
G	EN1	017333	030777	Q	PT	C20	R		1		T	T	TURBINE SPEED INCREASED TO 5625 RPM ;DIDNT TRIP	OUT OF ADJUSTMNT TRIP LINKAGE ON MECH OS
G	EN1	019648	072777	Q	PT	B09	S		1		T	T	COULD NOT RESET RCIC TURBINE ; TRIP-THROTLE VALVE	DIRTY CONTACTS WOULD NOT ACTUATE VALVE
G	EN1	020023	092377	Q	PT	B02	S		1		T	D	RCIC TURBINE TRIP THROTTLE VALVE FAILD TO REOPEN	LOOSE BRUSH SPRING ON OPERATOR MOTOR
G	EN1	020153	120477	H	PT	C13	S		1		T	D	HPCI TURB GOVNOR STUCK,MANUALLY HAD TO FORCE GOVNR	DAMAGED ELEC. CONNECTOR ON FLEX CONDUIT
G	EN1	025369	022779	H	PT	D13			1		T	T	HPCI PUMP REQUIRED TO BE SECURED DUE TO VIBRATION	ACTUATOR ON TURBINE CONTROL LOOP FAILED
G	EN1	027818	120879	Q	PT	D09	S		1		N	T	RCIC TURBINE TRIPPED ON HIGH EXHUST PRESSURE	CLOGGED MANUAL CHECK VALVE
G	EN1	031141	051380	H	PT	D13	T		1		N	D	HPCI FAILED TO START AFTER REACTOR SCRAM	SPURIOUS HPCI HIGH STEAM FLOW SIGNAL
G	EN1	031265	051480	Q	PT	D13	R		1		N	U	RCIC PUMP TRIPPED ON MANUAL START	BELIEVED TO BE OVERSPEED TRIP,UNKN CAUSE
G	EN1	031287	052080	H	PT	C13	S		1		T	T	HPCI TURBINE SPEED CONTROL FOUND ERRATIC	RAMP GEN IN EGM FOUND DEFECTIVE
G	EN1	031601	061380	Q	PT	D13	S		1		N	T	RCIC TURBINE TRIPPED FOLLOWING A REACTOR SCRAM	EGR AND LIMIT SW ON TRIP VALVE MALFUNCT.
G	EN1	031658	062680	H	PT	D13	T		1		N	U	HPCI FAILED TO START AFTER REACTOR SCRAM	HI STEAM LINE FLOW SIG DUE TO TURBINE CON
G	EN1	032130	072580	H	PT	C13			1		T	T	HPCI TURBINE FAILED TO TRIP AT OVERSPEED SETPOINT	WEAR TO TRIP DEVICE CAUSE SETPOINT DRIFT
G	EN1	032720	091980	H	PT	D00			1		T	U	DURING HPCI PUMP OP TEST,HPCI SYS ISOLATED	CAUSE UNKNOWN
G	EN2	022023	072578	Q	PT	B13	S		1		T	D	RCIC TURBINE FAILED TO START MANUALLY	SET POINT DRIFT OF OVERSPEED TRIP
G	EN2	022753	110678	H	PT	B02	U		1		T	D	HPCI PUMP FAILED TO QUICK START	WIRE ON CONTROL CIRCUIT NOT RECONNECTED
G	EN2	026030	060379	H	PT	B09			1		N	T	HPCI PUMP FAILED TO START-TURBINE STOP FAILD TO OP	WATER CONTAM OIL - SEAL LINE LEAKING
G	EN2	026035	060379	Q	PT	D12	S		1		N	T	RCIC PUMP FAILED TO RUN - RUPTURE DISC RUPTURED	DISCH CHK VLV DISC LOOSE - BLOCKED FLOW

ALL FAULTS IN TURBINE-DRIVEN BWR HPCI AND RCIC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	EN2	026149	060879	H	PT	D18	S	1		1	T	D	HPCI PUMP BECAME INOPERABLE	VAC AND CONDENSATE PUMPS TRIPPED
G	EN2	026340	062779	Q	PT	D02	S	1		1	N	D	RCIC CONDENSATE PUMP TRIPPED	PERSONNEL STEPPED ON MOTOR CONNECTING BOX
G	EN2	027781	112979	H	PT	D01	S	1		1	T	D	HPCI PUMP AUX LUBE OIL PUMP TRIPPED	HPCI PUMP WAS BEING SECURED INCORRECTLY
G	EN2	030234	013080	H	PT	D13	S	1		1	T	T	HPCI AUX LUBE OIL PUMP TRIPPED	TIME DELAY COIL IN BKR FAILED
G	EN2	030976	042280	Q	PT	D00		1		1	T	U	RCIC TRIP THROTTLE VALVE TRIPPED	UNKNOWN
G	EN2	031319	052180	Q	PT	D01		1		1	N	D	RCIC PUMP TRIPPED TWO TIMES FOLLOWING SCRAM	TEST POT SPEED CONTROL USED INSTEAD OF AU
G	FP1	012065	010275	Q	PT	C00		1		1	T	U	RCIC PUMP DID NOT ACHIEVE RATED FLO ON INI TEST	PASSED SUBSEQ TESTS, CAUSE UNKNOWN
G	FP1	012768	052275	Q	PT	D13	S	1		1	T	D	RCIC TURBINE TRIPPD;LOCAL TRIP LEVER ONLY PART ENG	READJUSTD TO FULLY ENGAGE
G	FP1	012769	052275	H	PT	D16	S	1		1	T	T	HPCI TURBINE TRIPPD ON LOW OIL PRESS.	LEAKS CAUSD A LOW OIL LEVEL &SYS. PRESSUR
G	FP1	013470	101175	H	PT	B09	S	1		1	T	D	HPCI STEAM SUPPLY 23MOV14 FAILD TO OPEN ON SIGNAL	PAPER HAD FALLEN BETWEEN OPERATR CONTACTS
G	FP1	013580	102975	H	PT	B04	T	1		1	T	D	HPCI AUTO STARTD THEN ISOLATD ON HI STEAM FLOW	SNUBBER PINS WERE RELOCATED
G	FP1	014488	032176	Q	PT	B03	U	1		1	T	D	BOTH EXHAUST RUPTURE DISKS RUPTURD DURIN FLOW TEST	MANUAL EXHAUST VALVE FULLY CLOSED
G	FP1	015062	061976	Q	PT	C10		1		1	T	T	RCIC TURBINE WOULD NOT TRIP WHEN REQUIRED TO	RUSTY LINKAGE CAUSD BY STEAM LEAK
G	FP1	016375	110976	H	PT	B04	T	1		1	N	D	HPCI STARTD THEN ISOLATED ;NEED STEAM SIGNAL SNUB	FLOW SNUBBERS ELIMINATED THE PROBLEM
G	FP1	017408	031477	Q	PT	B04	S	1		1	T	D	RCIC TURBINE TRIPPD DUE TO LOW OIL LEVEL	AUX.OIL SUMP INSTALLD PER VENDOR F.D.I.
G	FP1	017934	052177	Q	PT	B11	S	1		1	T	D	RCIC TURBINE DAMAGED BY OVERSPEED	OIL LINE FAILURE-HI FREQUENCY VIBRATION
G	FP1	019169	092877	Q	PT	B13	S	1		1	T	T	13 MOV131 STEAM SUPPLY TO RCIC TURBINE WOLDNT OPEN	TORQ SWITCH RESET SO VALV WOULD OPERATE
G	FP1	019868	122877	Q	PT	D09		1		1	N	T	RCIC PUMP 13-P-1 S/D TO ALLOW CLNG OF CUND FILTER	CUND OIL FILTER CLOGGED
G	FP1	021143	041078	Q	PT	C09	S	1		1	T	D	LIMIT SWITCH MALFUNCT ON 13MOV131--LOST SPEED CONT	DIRT ON CONTACTS CAUSD LOSS OF CONTINUITY
G	MO1	002172	073172	H	PT	E09	U	1		1	T	U	HPCI TURBINE TRIPPD ON OVERSPEED FOLLOWING MAINT.	PLASTIC FRAGMENTS FOUND IN OIL INLET PORT
G	MO1	001162	051873	H	PT	C13	S	1		1	U	U	EXCESSIVE STEAM FLOW TO HPCI ISOLATED HPCT FROM RX	EXCESSIVE STEAM FLOW TO HPCI ISOLATED HPC
G	MO1	010267	052174	H	PT	B13	S	1		1	T	D	HPCI TURB AUX OIL PUMP FAILED TO START	ACCEL RELAY AUX CONTACT ASSY DISLOCATED
G	MO1	013712	111875	Q	PT	B10		1		1	T	T	RCIC TURBINE FAILD ON FAST START;STEAM CONTROL VLV	CORROSION AND CRUD ON VALV STEM AND PIVOT
G	MO1	014446	040576	Q	PT	B04	S	1		1	T	D	TURBINE TRIPPD ONCE ON HI EXHAUST LINE PRESSURE	RAISD TRIP SETPOINT FROM 25 TO 40 PSIG
G	MO1	015440A	080276	Q	PT	D11	T	1		1	T	T	RCIC TURBINE TRIPPED ON OVERSPEED	STEAM VOID IN DISCH PIPING - VLV LEAKAGE

ALL FAULTS IN TURBINE-DRIVEN BWR HPCI AND RCIC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	M01	0154408	083076	Q	PT	D11		T	1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED	STEAM VOID IN DISCH PIPING - VLV LEAKAGE
G	M01	019670	080577	H	PT	C13		S	1		T	T	GOVENOR CONTROL SYS. FAILD RESULTING IN LOSS OF OC	FAILD RESISTOR
G	M01	026379	070279	H	PT	D05			1		T	T	HPCI GOVENOR END BEARING HAD HIGH TEMP AND VIBRA.	WORN LUBE OIL PUMP DUE TO WRONG METAL USE
G	P82	000673	121273	H	PT	D04		S	1		T	D	OIL LINE FAILD IN TURBINE CONTROL SYSTEM	SHEAR FAILURE IN THREADED PIPE SECT
G	P82	000641	122473	Q	PT	B06		S	1		T	D	TURBINE TRIPPD ON 3 OCCASIONS;IMPROPR ADJUSTMENT	LINKAGE BETWEEN TRIP VALVE AND OS TRIP
G	P82	000933	032474	H	PT	B13		T	1		T	U	TURBINE CONT VALVE AO-16C FAILD TO OPEN POSITION	OPEN CKT. CAUSD BY FAILD LOCAL SPEED POT.
G	P82	000989	041674	H	PT	B13		S	1		T	T	TURBINE ISOLATED UPON AUTO INITIATION; HI STEAM FL	RAMP GENERATR OUT OF CAL GAVE HI FLOW IND
G	P82	010051	042774	H	PT	B04		S	1		T	D	TURBINE ISOLATED AFTR COLD QUICK START ON HI FLOW	AIR ACCUMULATES IN HYD.CYL OF STOP VALVE
G	P82	010179	050774	Q	PT	B13		T	1		T	U	OUTBOARD ISO. VALVE MOV13-16 FAILD TO OPEN	MOTOR FAILURE;REPLACED DURIN SHUTDOWN
G	P82	015233	071976	H	PT	C13		T	1		T	T	TURBINE SPEED COULD NOT BE CONTROLLED	FAILD ELECTRONIC PARTS IN SPEED CONT.SYS.
G	P82	016142	100576	Q	PT	B13		S	1		T	U	RCIC TRIP THROTTLE VALV WOULDNT RESET AFTR TRIPPIN	GROUNDED WIRE ON TRIP SOLENOID
G	P82	016779	122876	Q	PT	B13		T	1		T	D	STEAM SUPPLY ISO. VLVE MO-13-16 FAILD TO OPEN	FAILD CLOSE TORQ SWITCH DAMAGD VLVE MOTOR
G	P82	019187	092677	H	PT	B13			1		T	T	HPCI INOPER--OIL LEAK ON HPCI OIL CONTROL VALVE	LEAKING DIAPHRAM; REPLACED WITH NEW DIAPH
G	P82	020525	020778	H	PT	B02	U		1		T	D	TURBINE TRIPPD ON OVERSPEED; AUTO START TESTING	MISCALIBRATION OF TURBINE SPEED CONTROL
G	P82	022284	090178	H	PT	B18			1		T	T	AUX OIL PUMP FOR HPCI SYS FAILED TO START	GROUND IN MOTOR
G	P83	011037	112574	H	PT	B00			1		T	U	DURIN 100 PERCENT ISOLATION TEST, HPCI ISOLATED BY	A TRANSIENT --CAUSE NOT IDENTIFIED
G	P83	014518	042976	H	PT	B13		S	1		N	D	HI STEAM FLOW TRIPPD HPCI TURBINE FOLLOWING SCRAM	RAPID OPENING OF TURBINE STOP VALVE
G	P83	018416	072177	H	PT	C13			1		T	U	TURBINE SPEED CONTROL ERRATIC;RCIC WAS OUT OF SERV	BENT LIFT RODS IN TURBINE CONTROL VALVE
G	P83	019716	093077	H	PT	C13		S	1		T	U	HPCI FLOW CONTRLLR FC-3-23-108 DEFECTIVE	CIRCUIT BOARD MODULE FAILD
G	P83	022080	080978	H	PT	C13		S	1		N	T	HPCI PUMP FAILED TO REACH RATE FLOW	HIGH AND LOW SPEED POTENTIOMETERS OOC
G	P83	022852	110678	H	PT	D13		R	1		N	T	HPCI PUMP APPARENTLY TRIPPED ON OVERSPEED	GOVENOR OUT OF CALIBRATION
G	P11	002229	123072	Q	PT	D07			1		T	T	RCIC TURBINE OIL PRESS LOST WHILE OPERTNG IN TEST	WORN GEARS IN DRVE TRAIN OF SHFT L.O.PUMP
G	P11	001079	011673	H	PT	B06		S	1		T	D	HPCI TURBINE TRIPPED ON OVERSPEED DURING START	TEST PROCEDURE USED WAS INADEQUATE
G	P11	011041	110874	Q	PT	D00		S	1		T	U	RCIC STEAM SUPPLY LINE ISOLATED DUE TO SPURIOUS S	NO CAUSE IDENTIFIED
G	P11	013113	060875	Q	PT	B00			1		T	U	OVERSPEED TRIP OF TURBINE DURING STARTUP	NO APPARENT CAUSE

ALL FAULTS IN TURBINE-DRIVEN BWR HPCI AND RCIC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	PI1	020675	030578	H	PT	B09		S	1		N	T	TURBINE STOP VALVE FAILD TO OPEN AFTR REACTOR SCRM	DIRTY DUPLEX OIL FILTER
G	PI1	023395	123078	H	PT	D18			1		T	U	HPCI PUMP TRIPPED IN FULL FLOW TEST	OIL FITTING LEAKED AND LOST LUBE OIL
G	PI1	025165	021479	H	PT	D18		S	1		T	U	HPCI TURBINE TRIPPED DURING TEST	GASKET ON GLAND SEAL CONDENSER RUPTURED
G	PI1	025707	041579	Q	PT	D13		S	1		T	D	RCIC CONDENSATE PUMP TRIPPED	BAD RELAY IN PUMP START LOGIC
G	PI1	031557	053080	Q	PT	C13		S	1		T	T	RCIC TURBINE FLOW AND PRESSURE DID NOT MEET T.S.	AUTO FLOW CONTROL FOUND FAULTY
G	QC1	000879	031074	Q	PT	B13		S	1		T	T	RCIC INOPERATIVE;TURBINE STEAM INLET VALVE 1301-61	EXCESSIVE WEAR CAUSD CAM AND TRIP LEVER
G	QC1	010516	072074	H	PT	C01		U	1		T	D	HPCI SPEED CHANGR MOTOR INOPER. CONT.POWR FUSES BL	SYS.IMPROPRLY TAKEN OUT OF SERVICE EARLER
G	QC1	015194	061776	H	PT	C13			1		T	D	SPEED CHANGER MOTOR FAILD TO OPERATE	BOUND DUE TO INADEQUATE LUBRICATION
G	QC1	016457	102976	Q	PT	C14			1		T	U	OPERBLTY SURVEILNC OF RCIC PMP COULDNT MEET TECHS	5 STAGES WERE SEVERLY DAMAGED
G	QC1	020596A	012378	Q	PT	C09			1		T	T	RCIC PUMP TURBINE SPEED ERRATIC	DIRTY CONT LNKGE STICKING DURING OPERATN
G	QC1	021437	050578	Q	PT	D09		R	1		T	T	RCIC PUMP REPEATEDLY TRIPPED ON OVERSPEED TRIP	DIRTY BALL AND TAPPET ASSEM. ON O.S. TRIP
G	QC1	022190	080778	Q	PT	D13		R	1		T	D	RCIC TURBINE TRIPPED ON OVERSPEED TEST	BALL AND TAPPET ASSEM BENT, REPLACED
G	QC2	002211	102172	H	PT	B00			1		T	U	HPCI TURBINE STOP VALVE WOULD NOT OPEN	CAUSE NOT DETERMINED
G	QC2	010592	083174	H	PT	B13		S	1		N	D	HPCI WOULDNT START BECAUSE VALVES WOULD NOT OPER.	250 VDC BATTRY DISCHRGD;CHRGR BKR TRIPPD
G	QC2	012801	041875	H	PT	B04			1		T	D	HPCI TURBINE STOP VALV WOULDNT OPEN DURNG ACT TEST	AUX OIL PMP AUTO TRIPPD WHEN EMER OIL PAN
G	QC2	013085	072975	H	PT	C13			1		T	U	TURBINE DRIVEN HPCI PUMP FLOW RATE INADEQUATE	IMPROPER PINNING OF PILOT VLV LEVER ARM
G	QC2	013257	083075	H	PT	B16		S	1		T	U	HPCI SYS. INOPERABLE DUE TO BREAK IN HI PRESS OIL	HI PRESS OIL DISCHARGE LINE REPLACED
G	QC2	013258	083075	Q	PT	D13			1		T	T	RCIC PMP TURBINE KEPT TRIPPING AT 3500 RPM	WORN NUT IN OVERSPEED TRIP MECHANISM
G	QC2	014098	123175	Q	PT	B05			1		T	D	TRIP THROTTL VLVE MECHANICAL OPERATOR WOLDNT RESET	REPLACEMENT TAPPET LONGER THAN ORIGINAL
G	QC2	017356	012877	H	PT	C00			1		T	U	HPCI FLOW DESIRED COULD NOT BE OBTAINED	APPEARS TO BE A TURBINE PROBLEM
G	QC2	017257	020977	H	PT	B09		S	1		T	T	TURBINE FAILD TO START DUE TO EXCSSV OIL PRESSURE	DIRT CLOGGD ORIFICE CONTROLING OIL PRESS.
G	QC2	020596B	020678	Q	PT	D13			1		T	U	RCIC PUMP TURBINE TRIPPED AT 3700 RPM	IMPROPER TENSION ON A SPRING - READJUSTED
G	QC2	021790	061478	H	PT	C13			1		T	T	HPCI TURBINE SPEED COULD NOT BE OBTAINED	JAM NUT ON ROD END BECAME LOOSE
G	VY1	030059	010380	H	PT	D13			1		T	U	HPCI PUMP TRIPPED AFTER STARTING	HI EXHUST PRESSURE OR AUTO ISOLATION
G	VY1	030286	012880	H	PT	B13			1		T	T	HPCI PUMP GOVENOR VALVE WOULD NOT REOPEN	SHORT BETWEEN EGM & EGR ACT OR STUCK EGR

ALL FAULTS I[illegible] TURBINE-DRIVEN BWR HPCI AND RCIC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	VY1	030734	0[illegible]6[illegible]0	H	PT	C13			1		T	T	HPCI PUMP WOULD NOT INCREASE ABOVE 800 RPM	FAILED FLOW CONTROLLER

Other Standby Pumps

The pumps considered are: BWR core spray pumps; containment spray pumps; PWR HCPI pumps; LPCI pumps; and BWR standby liquid control pumps. The exposure hours used for the different systems are listed in Table B-1.

The common cause failures to start were all command faults rather than failures. Therefore, quantities involving p cannot be estimated for failures.

Rates are estimated for

1. Failure to start, based on all faults

2. Failure to start, based on failures only

3. Failure to operate after starting, based on all faults

4. Failure to operate after starting, based on failures only.

Be sure to read the Application section in the main body of this report. The following computer printouts give the estimates and summaries of the relevant data.

STANDBY PUMPS: CONT SPR, LPCI, PWR HPCI, BWR CORE SPR, BWR ST LIQ CONT
FAILURE TO START
ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS
RATES ARE PER EXPOSURE HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.158, .278, .410)
LAMBDA = (1.1E-09, 3.0E-06, 1.3E-05)
LAMBDA+ = (1.5E-06, 2.3E-06, 3.2E-06)
OMEGA = (1.3E-07, 4.1E-07, 8.3E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
2	(2.9E-06, 5.2E-06, 8.7E-06)	(1.4E-06, 4.8E-06, 1.6E-05)	(.046, .277, .474)
3	(2.3E-06, 3.9E-06, 6.4E-06)	(1.2E-06, 4.5E-06, 1.5E-05)	(.050, .334, .574)
4	(2.0E-06, 3.4E-06, 5.2E-06)	(1.0E-06, 4.3E-06, 1.5E-05)	(.048, .343, .592)
6	(1.8E-06, 2.8E-06, 4.2E-06)	(9.1E-07, 4.2E-06, 1.5E-05)	(.041, .311, .600)
8	(1.7E-06, 2.6E-06, 3.7E-06)	(8.6E-07, 4.1E-06, 1.5E-05)	(.035, .269, .582)
OVERALL	(1.7E-06, 3.4E-06, 8.7E-06)	(8.6E-07, 4.3E-06, 1.6E-05)	(.035, .311, .600)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(4.0E-07, 7.9E-07, 1.3E-06)		
3	(3.4E-07, 7.1E-07, 1.2E-06)	(1.9E-07, 5.6E-07, 9.3E-07)	
4	(3.1E-07, 6.7E-07, 1.1E-06)	(1.8E-07, 4.9E-07, 9.1E-07)	(1.5E-07, 4.4E-07, 8.6E-07)
6	(2.8E-07, 6.3E-07, 1.1E-06)	(1.7E-07, 4.8E-07, 9.0E-07)	(1.4E-07, 4.4E-07, 8.5E-07)
8	(2.7E-07, 6.2E-07, 1.1E-06)	(1.7E-07, 4.8E-07, 9.0E-07)	(1.4E-07, 4.3E-07, 8.5E-07)
OVERALL	(2.7E-07, 6.7E-07, 1.3E-06)	(1.7E-07, 4.9E-07, 9.3E-07)	(1.4E-07, 4.4E-07, 8.6E-07)

STANDBY PUMPS: CONT SPR, LPCI, PWR HPCI, BWR CORE SPR, BWR ST LIQ CONT
FAILURE TO START
FAILURES ONLY, EXCLUDING COMMAND FAULTS
RATES ARE PER EXPOSURE HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

LAMBDA = (4.9E-17, 6.2E-07, 3.5E-06)
LAMBDA$_+$ = (2.3E-10, 5.9E-08, 2.3E-07)
OMEGA = (2.3E-10, 5.9E-08, 2.3E-07)

NO DATA WERE OBSERVED FOR ESTIMATING OTHER QUANTITIES

STANDBY PUMPS: CONT SPR, LPCI, PWR HPCI, BWR CORE SPR, BWR ST LIQ CONT
FAILURE TO OPERATE, GIVEN START
ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS
RATES ARE PER EXPOSURE HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.034, .206, .449)
LAMBDA = (2.7E-08, 2.2E-06, 7.6E-06)
LAMBDA$_+$ = (4.3E-07, 8.9E-07, 1.5E-06)
OMEGA = (2.1E-08, 1.8E-07, 4.6E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
2	(9.2E-07, 4.9E-06, 1.4E-05)	(5.9E-07, 2.8E-06, 8.3E-06)	(.019, .131, .406)
3	(7.4E-07, 3.5E-06, 9.2E-06)	(4.8E-07, 2.7E-06, 8.2E-06)	(.021, .149, .498)
4	(6.5E-07, 2.7E-06, 7.1E-06)	(4.3E-07, 2.7E-06, 8.1E-06)	(.021, .151, .529)
6	(5.6E-07, 2.0E-06, 4.9E-06)	(3.7E-07, 2.6E-06, 8.0E-06)	(.019, .141, .552)
8	(5.2E-07, 1.7E-06, 3.8E-06)	(3.5E-07, 2.6E-06, 8.0E-06)	(.017, .129, .558)
OVERALL	(5.2E-07, 2.7E-06, 1.4E-05)	(3.5E-07, 2.7E-06, 8.3E-06)	(.017, .141, .558)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(6.4E-08, 2.8E-07, 6.1E-07)		
3	(5.3E-08, 2.6E-07, 5.7E-07)	(3.0E-08, 2.0E-07, 4.9E-07)	
4	(4.8E-08, 2.5E-07, 5.6E-07)	(2.9E-08, 2.0E-07, 4.9E-07)	(2.4E-08, 1.9E-07, 4.7E-07)
6	(4.3E-08, 2.4E-07, 5.5E-07)	(2.8E-08, 2.0E-07, 4.9E-07)	(2.3E-08, 1.8E-07, 4.7E-07)
8	(4.1E-08, 2.3E-07, 5.4E-07)	(2.7E-08, 2.0E-07, 4.9E-07)	(2.3E-08, 1.8E-07, 4.7E-07)
OVERALL	(4.1E-08, 2.[illegible], 6.1E-07)	(2.7E-08, 2.0E-07, 4.9E-07)	(2.3E-08, 1.8E-07, 4.7E-07)

STANDBY PUMPS: CONT SPR, LPCI, PWR HPCI, BWR CORE SPR, BWR ST LIQ CONT
FAILURE TO OPERATE, GIVEN START
FAILURES ONLY, EXCLUDING COMMAND FAULTS
RATES ARE PER EXPOSURE HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.004, .246, .697)
LAMBDA = (1.8E-08, 2.0E-06, 7.4E-06)
LAMBDA$_+$ = (2.1E-08, 1.8E-07, 4.6E-07)
OMEGA = (2.3E-10, 5.9E-08, 2.3E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
2	(4.9E-08, 3.9E-05, 2.0E-05)	(1.4E-07, 2.2E-06, 7.5E-06)	(.001, .045, .422)
3	(4.1E-08, 2.6E-05, 1.3E-05)	(1.2E-07, 2.2E-06, 7.5E-06)	(.001, .045, .500)
4	(3.6E-08, 2.0E-05, 1.0E-05)	(1.1E-07, 2.2E-06, 7.5E-06)	(.001, .041, .473)
6	(3.2E-08, 1.3E-05, 6.8E-06)	(1.0E-07, 2.1E-06, 7.5E-06)	(.001, .035, .474)
8	(3.0E-08, 9.9E-06, 5.1E-06)	(9.6E-08, 2.1E-06, 7.5E-06)	(.000, .032, .468)
OVERALL	(3.0E-08, 2.0E-05, 2.0E-05)	(9.6E-08, 2.2E-06, 7.5E-06)	(.000, .041, .500)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(1.6E-09, 8.8E-08, 2.8E-07)		
3	(1.2E-09, 8.3E-08, 2.7E-07)	(5.5E-10, 7.1E-08, 2.5E-07)	
4	(1.1E-09, 8.2E-08, 2.7E-07)	(5.2E-10, 7.1E-08, 2.5E-07)	(3.9E-10, 6.6E-08, 2.4E-07)
6	(9.4E-10, 8.0E-08, 2.7E-07)	(5.0E-10, 7.0E-08, 2.5E-07)	(3.8E-10, 6.6E-08, 2.4E-07)
8	(8.8E-10, 7.9E-08, 2.7E-07)	(4.9E-10, 7.0E-08, 2.5E-07)	(3.8E-10, 6.6E-09, 2.4E-07)
OVERALL	(8.8E-10, 8.2E-08, 2.8E-07)	(4.9E-10, 7.1E-08, 2.5E-07)	(3.8E-10, 6.6E-09, 2.4E-07)

ALL FAILURES TO START IN STANDBY PUMPS: CONT. SPRAY, LPCI, PWR HPCI, BWR CORE SPRAY, AND BWR ST. LIQ. CONTROL

PLANT	CRIT. HOURS	CALEND. HOURS	POP	NUMBER OF INDIV. FAULTS FAILRS/COM FLTS	NUMBER OF NONLETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY NONLETHAL SHOCKS FAILRS/COM FLTS	NUMBER OF LETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY LETHAL SHOCKS FAILRS/COM FLTS
AR1	33594	53952	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CR3	17695	32544	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DB1	13042	26808	4	1 / 1	0 / 0	0 / 0	0 / 1	0 / 2
DE1	45079	65328	5	0 / 0	0 / 2	0 / 2	0 / 0	0 / 0
DE2	37558	60384	5	0 / 2	0 / 1	0 / 1	0 / 0	0 / 0
DE3	36816	53232	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RS1	29290	52968	4	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
TI1	31732	42192	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI2	3398	8784	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AR2	7068	15984	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	38451	52464	7	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC2	26811	33624	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FC1	47570	62712	8	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
MI2	30580	43464	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MY1	55878	69600	8	0 / 1	0 / 1	0 / 1	0 / 0	0 / 0
PA1	38960	76704	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SL1	26228	38952	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BV1	13775	38520	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC1	37510	49992	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC2	18811	22464	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	63506	76704	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	37770	64536	7	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0
IP3	26443	39336	7	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
JF1	16271	27576	4	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0
KE1	46125	57600	6	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA1	15859	21840	8	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
NA2	1724	2664	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	46464	59904	7	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	44184	50760	7	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
PT1	62073	76704	6	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PT2	64363	73104	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	58078	76704	7	0 / 9	0 / 0	0 / 0	0 / 0	0 / 0
RO2	60180	76704	7	2 / 2	0 / 1	0 / 2	0 / 2	0 / 5

SA1	16488	33360	6	1 / 1	0 / 1	0 / 2	0 / 0	0 / 0
SE1	542	2112	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	56392	76704	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	42519	72336	11	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	39584	66360	11	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
TR1	21998	42048	8	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
TU3	52966	69672	8	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
TU4	46080	64056	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
YR1	53515	76704	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	42451	63864	7	0 / 1	0 / 1	0 / 1	0 / 0	0 / 0
ZI2	37666	59352	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF1	32634	62448	10	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0
BF2	29788	54360	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF3	26961	36360	10	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
BP1	51445	76704	4	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
BR1	22445	34896	8	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
BR2	27176	48528	8	0 / 1	0 / 1	0 / 1	0 / 0	0 / 0
CO1	45502	57936	8	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DA1	35182	57216	8	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DR1	39786	59904	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	58693	76704	8	1 / 2	0 / 0	0 / 0	0 / 0	0 / 0
DR3	56458	76704	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN1	37105	53064	6	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
EN2	10147	19680	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FP1	30779	51480	8	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
MI1	58150	76704	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MO1	62706	76704	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NM1	58566	76704	17	0 / 3	0 / 0	0 / 0	0 / 0	0 / 0
OC1	55263	76704	17	1 / 8	0 / 2	0 / 3	0 / 0	0 / 0
PB2	40497	61728	10	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0
PB3	40274	53928	10	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PI1	48238	72696	8	1 / 3	0 / 0	0 / 0	0 / 0	0 / 0
QC1	56398	76704	8	0 / 1	0 / 1	0 / 1	0 / 0	0 / 0
QC2	56912	73920	8	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
VY1	57426	74712	8	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	2577618	3567552	497[A]	13 / 57	0 / 19	0 / 26	0 / 3	0 / 5

A. THIS COUNTS SHARED PUMPS ONLY ONCE.

ALL FAILURES TO OPERATE, GIVEN START, IN STANDBY PUMPS: CONT. SPRAY, LPCI, PWR HPCI, BWR CORE SPRAY, BWR ST. LIQ. CONTROL

PLANT	CRIT. HOURS	CALEND. HOURS	POP	NUMBER OF INDIV. FAULTS FAILRS/COM FLTS	NUMBER OF NONLETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY NONLETHAL SHOCKS FAILRS/COM FLTS	NUMBER OF LETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY LETHAL SHOCKS FAILRS/COM FLTS
AR1	33594	53952	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CR3	17695	32544	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DB1	13042	26808	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE1	45079	65328	5	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE2	37558	60384	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE3	36816	53232	5	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PS1	29290	52968	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI1	31732	42192	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI2	3398	8784	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AR2	7068	15984	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	38451	52464	7	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC2	26811	33624	7	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FC1	47570	62712	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI2	30580	43464	7	0 / 0	1 / 0	1 / 0	0 / 0	0 / 0
MY1	55878	69600	8	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
PA1	38960	76704	7	2 / 0	0 / 1	0 / 1	0 / 0	0 / 0
SL1	26228	38952	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BV1	13775	38520	10	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC1	37510	49992	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC2	16811	22464	6	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
HN1	63506	76704	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	37770	64536	7	3 / 0	0 / 0	0 / 0	0 / 1	0 / 3
IP3	26443	39336	7	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	16271	27576	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KE1	46125	57600	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA1	15859	21840	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA2	1724	2664	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	46464	59904	7	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	44184	50760	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT1	62073	76704	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT2	64363	73104	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	58078	76704	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RO2	60180	76704	7	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0

SA1	16488	33360	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SE1	542	2112	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	56392	76704	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	42519	72336	11	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	35584	66360	11	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TR1	21998	42048	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TU3	52966	69672	8	1 / 0	0 / 1	0 / 1	0 / 0	0 / 0	
TU4	46080	64056	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
YR1	53515	76704	6	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	42451	63864	7	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	37666	59352	7	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF1	32634	62448	10	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF2	29788	54360	10	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BF3	26961	38360	10	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BP1	51445	76704	4	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BP1	22445	34896	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BR2	27176	48528	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CO1	45502	57936	8	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DA1	35182	57216	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR1	39786	59904	8	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR2	58693	76704	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DR3	56458	76704	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN1	39105	53064	6	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
EN2	10147	19680	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FP1	30779	51480	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MI1	58150	76704	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MO1	62706	76704	8	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0	0 / 0
NM1	58566	76704	17	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
OC1	55263	76704	17	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB2	40497	61728	10	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PB3	40274	53928	10	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PI1	48238	72696	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC1	56398	76704	8	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
QC2	56912	73920	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
VY1	57426	74712	8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	2577618	3567552	497[A]	42 / 3	1 / 6	1 / 7	0 / 1	0 / 3	

A. THIS COUNTS SHARED PUMPS ONLY ONCE.

ALL FAULTS IN STANDBY PUMPS: CONT. SPRAY, LPCI, PWR HPCI, BWR CORE SPRAY, BWR ST. LIQ. CONTROL

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
B	DB1	020274*	011278	F	PM	U01		N	2	N	D		BOTH CONT SPRAY PMPS INOPERABLE R/X IN MODE 4	PUMP CKT.BKRS. RE-ENERGIZED
B	DB1	021855	061878	F	PM	B13		S	1	T	T		CONTAINMENT SPRAY PUMP FAILED TO START AUTOMATIC.	SFAS OUTPUT MODULE CAUSED FAILURE
B	DB1	030928	040680	F	PM	U02			1	N	D		OIL SIGHT GLASS FOR CONT SPRAY PUMP 1-2 BROKE	BROKEN BY CONTRUCTION PERSONNEL
B	DE1	014806A	012876	L	PM	B02		U	1	T	D		LOW PRESS INJECTION PUMP 1A - INOPERABLE	INCORRECT SUBSTITUTE BREAKER INSTALLED
B	DE1	014806B	012876	F	PM	B02		U	1	T	D		REACTOR BUILDING SPRAY PUMP - INOPERABLE (1A)	INCORRECT SUBSTITUTE BREAKER INSTALLED
B	DE1	025915	041979	F	PM	A05			1	T	D		1B RB SPRAY PUMP FOUND LEAKING AROUND VENT LINE	PLUG WAS SUPPOSED TO BE IN LOCATION OF VE
B	DE2	000577	111273	L	PM	B01		U	1	T	D		LOW PRESSURE INJECTION PUMP 2B FAILED TO START	BREAKER NOT RACKED IN PROPERLY
B	DE2	011071A	120974	L	PM	U08		S	1	T	D		COMMON SUCTION VALVE FOR 1 LPCI AND 1 CONT SPRAY P	UMP FAILED TO OPEN - OPEN CKT IN 1 PHASE
B	DE2	011071B	120974	F	PM	U08		S	1	T	D		COMMON SUCTION VALVE FOR 1 LPCI AND 1 CONT SPRAY P	UMP FAILED TO OPEN - OPEN CKT IN 1 PHASE
B	DE3	019484	090177	F	PM	D04			1	T	D		EXCESV NOIS DURNG VIBRTN TST OF 3B R/X BLDNG SPRAY	OIL LEVEL IND IMPROPERLY POSITIONED
B	DE3	023435	122078	F	PM	D14			1	T	T		REACTOR BUILDING SPRAY PUMP DECLARED INOPERABLE	HIGH VIBRATION DUE TO LOOSE IMPELLER
B	DE3	028046	040479	F	PM	D02			1	T	D		OIL DISCOVERED LEAKING FROM PUMP CASING, PUMP SEC.	BEARING CAP INSTALLED INCORRECTLY
B	RS1	016711	112376	F	PM	B01		U	1	T	D		RX BLDG SPRAY PUMP FAILED TO START	BRKR WAS NOT RACKED IN CORRECTLY
B	RS1	026886	071979	L	PM	A19		R	1	T	T		DHR PUMP "B" LEAKED IN EXCESS OF TECH SPEC	FAILED SEAL, SEAL REPLACED
C	CC1	011272	112574	F	PM	C07			1	T	T		DURING TEST, CONTAIN SPRAY PMP #11 TOH OOS LOW	NORMAL WEAR OF PUMP INTERNALS
C	CC1	015223	062176	F	PM	U12		R	1	N	T		NO 12 CONTAINMENT SPRAY PUMP WAS TAKEN OUT OF SERV	REPAIR SMALL LEAK IN SEAL WTR PIPE NIPPLE
C	CC1	018287	062277	F	PM	U12		R	1	N	T		NO 12 CONTAINMENT SPRAY PUMP WAS TAKEN OUT OF SERV	LEAKING SEAL WTR COOLER CASING FITTINGS
C	CC2	027373	102779	H	PM	D19			1	N	T		HPSI PUMP "A" FAILED, REQUIRING SECURING THE PUMP	MECHANICAL SEALS FAILED ON #22 HPCI PUMP
C	CC2	030678A	022580	L	PM	D00			1	U	U		LPSI PUMP 21 TAKEN OUT OF SERVICE FOR CORR. MAINT.	CAUSE NOT GIVEN
C	CC2	030678B	022580	F	PM	D02			1	U	U		CONT SPR PUMP 21 TAKEN OOS BY MISTAKE	MISUNDERSTANDING, SHD HAVE BEEN LPSI 21
C	FC1	025844	042079	F	PM	B01		U	1	T	D		CONTAINMENT SPRAY PUMP FAILED TO START (SI-3B)	SUPPLY BREAKER BOUND DUE TO PERSONNEL ER.
C	MI2	031945	070380	H	PM	D05		C	1	T	D		"A" HPCI PUMP SEIZED	PROCEDURE DID NOT REQUIRE MIN FLOW VLV OP
C	MY1	002322	120272	H	PM	B02		U	1	T	D		HPSI P-145 SUPPLIED BY "A" DG DID NOT START	GROUNDING BLOCK NOT REMOVED FROM CKT BKR
C	MY1	027208	091879	F	PM	C03		U	1	T	D		"B" TRAIN CONTAINMENT SPRAY PUMP DIS PRESS DROPPED	SUCTION VALVE WAS CLOSED
C	MY1	027289	100379	F	PM	B13		S	1	T	T		"A" TRAIN CONTAINMENT SPRAY PUMP FAILED TO START	CONTACT BLOCK IN PUMP BKR FAIL TO MADE UP

ALL FAULTS IN STANDBY PUMPS: CONT. SPRAY, LPCI, PWR HPCI, BWR CORE SPRAY, BWR ST. LIQ. CONTROL

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
C	PA1	010659	071174	H	PM	C04			1		T	D	HPSI P66A TESTED UNSAT SHUTOFF HEAD NOT DEVELOPD	6TH STAGE IMPELLOR MOVED ON SHAFT
C	PA1	013008	070975	L	PM	C01		U	1		T	D	LPSI PUMP 67B NO FLOW, NO PRESSURE	TWO VALVES NOT IN CORRECT POSITION
C	PA1	013820	112275	L	PM	A04			1		N	D	LPSI PMP SEAL LEAKG PMP TYPE 8X21 A1,SER A-67393	IMPRPR ORING CLEARANCE
W	BV1	020132	121677	L	PM	D20			1		T	T	1A LHSI PUMP SHUTDOWN DUE TO HI VIBRATION ON SHAFT	PUMP-TO-MOTOR MISALIGNMENT
W	BV1	028105	091079	L	PM	C09			1		T	D	LHSI PUMP FAILED TO REACH REQUIRED RECIRC FLOW	PIECES OF PLASTIC FIRE HOSE NOZZLE FOUND
W	DC2	032628	090480	L	PM	C06		U	1		T	D	EAST RHR PUMP WAS FOUND UNSTABLE	ALL AIR WAS NOT REMOVED FROM SERVICE
W	HN1	021329	040378	H	PM	C14			1		M	U	"A" HPSI PMP DEVELOPED UNUSUAL DRAG DURING MAINT	INSPECTION DISCLSD CRKD WR RNGS & BSHNGS
W	IP2	010282	051074	H	PM	B09		U	2		M	T	#23 & #21 HPSI PUMP STARTED ONLY DEVELOP 700# PRS	BORIC ACID LEAKAGE CAUSD SUCTION BLOCKAGE
W	IP2	012862	052275	L	PM	A16			1		N	D	RHR PMP #21 REMOVED FROM SERVICE TO REPAIR SEAL HX	LEAKNG SEAL HEAT XCHGR - PMP MOD# 8X20
W	IP2	015920*	080576	H	PM	C03	N		3		T	D	ALL 3 SAFETY INJ PUMPS RUN APPX 10 MIN W/O SUCTION	CNN PUMP SUCTION VLV (846) NOT OPEN
W	IP2	018789	052577	L	PM	A19			1		N	T	#22 RHR PUMP REMOVED FROM SERVICE	MECH SEAL ASSY GSKT DETERATD AND LEAKED
W	IP2	021706	060278	H	PM	D21			1		T	T	EXCESS OIL FROM SI PUMP NO. 22 THRUST BEARING	THRUST COLLAR AND SHOES FAILED,REPLACED
W	IP3	016944	011277	H	PM	B13	S		1		N	D	#33 SI PMP FAILD TO START FROM SIS;PLANT TRIP 100%	TD RELAY IN START CKT FAILD MODEL 2412PC
W	IP3	017878	040477	H	PM	C14			1		R	T	NO. 31 SAFTY INJ PMP HAD GRAD DETERATN OF FLO OUPT	WORN INTERNALS - HIGH HEAD TYPE JTCH
W	IP3	021036	032878	L	PM	A16			1		N	U	#31 RHR PUMP REMOVED FROM SERVICE	GSKT BTWN GLND PLATE AND PMP CASING LKNG
W	JF1	022631*	091778	F	PM	U01		U	2		N	D	BOTH CONTMT SPRAY PMP SUPPLY BREAKERS TAGGED OPEN	BOTH TRAINS REQUIRED BY TECH SPECS
W	KE1	019313	100777	F	PM	B00	R		1		T	D	SPRAY PMP FAILD TO START DUE TO OVERCURRENT TRIP	START CURRENT G.T. SETPOINT; RAISED SETPT
W	KE1	019518	102477	F	PM	B00	R		1		N	D	A CONTAINMT SPRAY PUMP FAILED TO START DURING TSTG	CAUSE UNKWN - BKR WAS TRIPPED ON OVRCURNT
W	KE1	020094	122377	F	PM	B00	R		1		T	D	ICS PMP 1B FAILED TO START DURING OPERATIONAL TEST	CAUSE UNKNOWN - BRKR OPERTG ERRATICALLY
W	NA1	021665	060678	F	PM	B09	S		1		T	D	CONT QUENCH SPRY PUMP 1-QS-P-1A FAILED TO START RE	SCREW FOUND IN SUPPLY BKR (FOREIGN)
W	NA1	021890	061578	F	PM	B13	S		1		T	D	QUENCH SPRAY PUMP 1-QS-P-1B FAILED TO START	BKR CHR SPRING MOTOR SWITCH IN OFF POSI.
W	PR1	017619	041177	H	PM	D04			1		T	D	#12 SAFTY INJ PMP #2IMPELLR MOVED AXIALLY ON SHAFT	ABNORMAL PRESSURE DISTRBTION ACROSS IMPLR
W	PR1	026014	040879	H	PM	B02			1		T	U	#11 SAFETY INJECTION PUMP FAILED TO START IN AUTO	UNKNOWN CAUSE,EVENT COULD NOT BE REPEATED
W	PR2	021038	041778	L	PM	U01		U	1		N	D	OPERATOR PLACED #22 RHR PUMP OOS - AUX OPER OPENED	CKT BRKR FOR # 21 RHR PUMP - PERSONNEL ER
W	PT1	010648	062174	F	PM	B13	T		1		U	D	CONTAINMENT SPRAY PUMP 1P14A DID NOT START	PUMP BRKR LATCH WAS NOT FULLY ENGAGED

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VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	PT1	021765*	063078	F	PM	B13		T	1		N	D	CONTAINMENT SPRAY PUMP 1-P148 DECLARED OOS	POWER SUPPLY BKR WOULD NOT RACK IN
W	RG1	001037	061173	H	PM	B13		T	1		T	D	SAFETY INJECTION PUMP 1C FAILED TO START	BENT OPERATOR ARM ON THE CELL SWITCH
W	RG1	010046	040674	H	PM	B13		T	1		T	D	1C SAFETY INJECTION PUMP FAILED TO START MANUALLY	PREMATURE CLOSING OF CB TRIP BAR
W	RG1	010664	080774	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 16	MAY BE FAULTY LOCKOUT INTERLOCK
W	RG1	012136A	020575	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 16	REP WEAK SPRING AND TIGHTENED WIRE IN CB
W	RG1	012136B	020675	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 16	REP WEAK SPRING AND TIGHTENED WIRE IN CB
W	RG1	012397	021875	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 16	MECH BINDING ON LOCKOUT SOLENOID PLUNGER
W	RG1	016716	010377	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 14	WEAK SPRING IN SECONDARY CONTACT ASSY
W	RG1	018244	062977	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 14	NO APPARENT CAUSE FOR CB FAILURE
W	RG1	021670	052978	F	PM	B13		S	1		T	T	CSI PUMP FAILED TO START	FAILED CIRCUIT BKR
W	RO2	002067	060772	F	PM	B14			1		U	U	ONE OF THE CONTAINMT SPRAY PMPS FOUND TO BE BINDNG	BURR ON IMPELLER GALLED THE SEAL RING
W	RO2	000184*	070973	H	PM	B02		U	2		U	D	SAFTY INJECTION PMPS "B"&"C" TRIPPD ON MANUAL STAR	INSTANTNS TRIP SETTINGS WERE SET AT MIN.
W	RO2	017585	032477	F	PM	U02		S	1		N	D	CONTMT SPRAY PMP A NOT ON SVC DURING CRITICALITY	PERSONNEL HAD REMOVED PUMP FROM SERVICE
W	RO2	019793A	112377	H	PM	U01		N	3		N	D	BREAKERS FOR ALL 3 SAFETY INJ PMPS FOUND RAKD OUT	FAILURE TO RECOG TS LIMIT FOR GT 200 F OP
W	RO2	019793B	112377	F	PM	U01		N	2		N	D	BREAKERS FOR BOTH CONT SPRAY PMPS FOUND RAKD OUT	FAILURE TO RECOG TS LIMIT FOR GT 200 F OP
W	RO2	022614*	100378	F	PM	C06		U	2		T	D	BOTH OF THE CONTAINMENT SPRAY PUMPS FOUND AIRBOUND	PUMPS NOT VENTED AFTER SYSTEM REALIGNED
W	RO2	026063	041479	H	PM	B00			1		T	U	'A' SI PUMP FAILED TO START	CAUSE UNKNOWN
W	RO2	032732	081180	H	PM	B13		S	1		T	T	'A' SI PUMP BKR FAILED TO CLOSE	HIGH RESISTANCE ALARM SWITCH CONTACT
W	SA1	017700A	050677	H	PM	U01		U	2		R	D	BOTH SI PUMPS AND 1 CENTRIFUGAL CHG PMP TAGGED OUT	PERSONNEL ERROR - NOT FOLLOWING PROCEDURE
W	SA1	023232B	112778	L	PM	B13		T	1		N	T	NO ? RHR PUMP FAILED TO START DURING SI	BUS FAILURE DUE TO OUTPUT TRANSF FAILED
W	SA1	028006	112879	H	PM	B14		R	1		N	D	S[illegible] UMP FAILED,LOOSE LOCKNUTS FOUND,SHAFT BENT	REVERSE ROTATION POSSIBLE CAUSE,#12 PUMP
W	SU1	021521	051078	F	PM	D09			1		T	D	INSIDE RECIRC SPRAY PUMP RS-P-1A FAILED TO ROTATE	FORFIGN MAT. BETWEEN IMPELL AND WEAR RING
W	SU2	000519	111373	H	PM	B02		U	1		U	D	SAFETY INJ/CHG PUMP 2-CH-P-1B DID NOT START-MANUAL	FUSES WERE NOT INSTALLED IN CONT CIRCUITS
W	TR1	017572	030277	H	PM	B13		T	1		N	D	ONE OF TWO SAFETY INJ PUMPS FAILED TO START	IMPROPER ACTUATION OF DBA SEQ CONTACTS
W	TR1	019168A	052877	H	PM	B13		T	1		T	D	B SAFETY INJ PUMP DID NOT START - AUTOMATIC	SEQUENCER CONTACTS OPER WITH TOO LOW CRNT

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W	TU3	000780	020574	H	PM	B13	S		1		N	D	3A SAFETY INJ PUMP FAILED TO START	INSUFFICIENT CHARGE ON BRKR CLSG SPRING
W	TU3	010136	050374	H	PM	C11	U		1		N	D	SAFT INJ PMP STOPPD WHEN LOW RUN CURRNT/PRESS SEEN	AIR LEAKAGE INTO PUMP CASING
W	TU3	025775	030279	H	PM	C17			1		M	U	3B SI PUMP FOUND TO BE RUBBING	CAUSE UNKNOWN, IMPELLERS MOVED
W	TU4	019700	110977	F	PM	D00			1		N	U	4B CONT SPRAY PMP INBOARD BRNG OVRHEATD	MODEL 3736 4X6-13DV 1450GPM AT 470 FT
W	YR1	016649	121676	H	PM	A16			1		T	T	#1 HPSI PMP SHAFT HOUSNG SEAL LEAKED	CUT IN GASKET BETWN HOUSNG/STUFFNG BOX
W	YR1	016862	010777	L	PM	A07			1		T	T	PACKING GLND ON #1 LPSI LEAKED EXCESSVELY	PACKN REACHD END OF LIFE REPLACD PACKING
W	YR1	020071	122977	L	PM	D04			1		T	D	#3 LPSI OUTBRD SHFT PACKN GLAND OVERHEATD, PUMP S/D	INSUFCNT CLEARNCE BETWEEN SHFT/PACKN GLND
W	ZI1	010082	042774	F	PM	B06	U		1		U	D	1B CONTAINMENT SPRAY PUMP DID NOT START	BRKR RACKED IN TO WRONG POSITION
W	ZI1	013217	082575	F	PD	B13	S		1		T	T	CONTAINMENT SPRAY DIESEL FAILED TO START	DIESEL STARTING BATTERIES FAILED
W	ZI1	023442	122678	F	PD	D18			1		T	T	CONTAINMENT SPRAY PUMP 1C DEVELOPED HOSE RUPTURE	COOLING SYS HOSE ON DIESEL BROKE
W	ZI2	010709	071274	F	PD	C02	S		1		T	D	CONT SPRY INJ PMP 2C OPERATD 10% BELOW NORMAL HEAD	MAN CONT VALV NOT PROPERLY LOCKED
W	ZI2	022996	110878	F	PD	D18			1		T	T	CONTAINMENT SPRY PUMP 2C DEVELOPED HOSE RUPTURE	COOLING SYS HOSE ON DIESEL BROKE
G	BF1	000713	011774	U	PM	A19			1		T	T	1B STBY LIQUID CONT PUMP FAILED SURVEILLANCE TEST	PACKING ON 1 OF 3 PUMP PLUNGERS FAILED
G	BF1	010377*	061874	D	PM	B13	U		2		T	D	1B & 1C COR SPRA DIDNT START DURIN SURVLLNC TESTIN	BENT CONTACT ARM ON RELAY (MANUAL START)
G	BF2	022085	080578	U	PM	C07			1		T	T	2B STANDBY LIQUID CONTROL PUMP FAILED TO REACH CAP	NORMAL WEAR TO VALVE, SEATING SURFACES
G	BF3	016057	092376	L	PM	B13	S		1		T	U	RHR PMP 3C FAILD TO START ON NORMAL POWER	OPEN CABLE IN RHR LOGIC
G	BF3	032025	071480	L	PM	D13	S		1		T	D	3D RHR PUMP TRIPPED ON INSTANTANEOUS OVERCURRENT	POSSIBLE INCORRECT SETPOINT OF RELAY
G	BP1	019025	082977	F	PD	B13	S		1		T	D	DIESEL FIRE PUMP FAILED TO START DURING REFUELING	2 BATTRY CABLES LOOSE; B BATTRY WAS DISCH
G	BR1	019677	110577	L	PM	B02	S		1		T	T	RHR 1A DID NOT START; COVER LOOSE & CONTACTS CORRD	CORRODED DUE TO WATER LEAKS
G	BR1	025041	010979	L	PM	B13	S		1		T	D	RHR PUMP "D" WOULD NOT START	INTERNAL PROBLEMS IN CIRCUIT BKR
G	BR1	030408	021480	L	PM	D00			1		T	U	1D RHR PUMP TRIPPED IN TORUS COOLING MODE	CAUSE UNKNOWN, BKR RESET AND PUMP STARTED
G	BR2	017186	020777	D	PM	B13	S		1		T	U	CORE SPRAY 2B FAILD TO START--BKR CHARGIN SPRING	CHARG. SPRING MANUALLY CHARGED, BKR CLOSED
G	BR2	019676	062277	L	PM	B01	U		1		T	D	RHR 2A CHARGN MOTOR SWITCH IN OFF POSITION	PERSONEL LEFT SWITCH IN OFF POSITION
G	CO1	020049A	112177	U	PM	A05			1		T	D	"B"SBLC PUMP STUFFING BX GLAND FOLLOWER BLEW OUT	MOVEMENT OF INSUFF CONTAINED GLAND FLWR
G	CO1	020049B	112177	U	PM	C05			1		T	D	"B"SBLC PUMP FAILED TO MEET REQD FLOW AT PRESSURE	3 IN LIEU OF 5 PKG RINGS INSTLLD BY MFGR

ALL FAULTS IN STANDBY PUMPS: CONT. SPRAY, LPCI, PWR HPCI, BWR CORE SPRAY, BWR ST. LIQ. CONTROL

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G	CO1	027957	122379	L	PM	B13		S	1		N	D	RHR PUMP "1D" WOULD NOT OPERATE	BREAKER FAILURE
G	CO1	030788	031080	U	PM	C07			1		T	T	SLC PUMP 1B WOULD NOT PUMP REQUIRED FLOW RATE	LEAKING INTERNAL SUCTION AND DISCH VALVES
G	DA1	012848	061375	D	PM	B09		S	1		N	D	CORE SPRAY PMP 211A DID NOT START ON SIGNAL	DIRTY AUX CONTACTS ON 4KV CKT BKR
G	DR1	000427	092873	D	PM	D19			1		U	T	1A CORE SPRAY PUMP INOPERABLE DUE TO SMOKING PKG	METALIC PKG SCORED SHFT SLV AND DISTORTED
G	DR1	017321	100477	D	PM	D19			1		T	U	B CORE SPRAY PUMP PACKING OVR HEATED, BEGAN SMKING	PUMP LAST PKD 11/16/76, LAST TSTD 9/20/77
G	DR2	002284	030572	L	PM	B09		T	1		T	D	2C LPCI FAILD TO START DURING TEST	DIRTY CONTACTS IN 4KV ECCS BREAKERS
G	DR2	015195	062576	L	PM	B19		T	1		N	D	2C LPCI FAILD TO START FOR MAINTNG TORUS WTR. TEMP	DIRTY SWITCH IN 4KV BKR FOR PUMP
G	DR2	025953	041579	L	PM	B00			1		T	U	2A LPCI PUMP WOULD NOT START	CAUSE UNKNOWN
G	DR2	032415	081880	L	PM	A09			1		N	T	2A LPCI PUMP SEAL FOUND LEAKING	SEAL FAILED DUE TO DIRT ON SEALING SURF.
G	EN1	012973	070175	L	PM	B13		S	1		T	D	RHR 1B AIR CKT BKR FAILD TO CLOSE	SLIPPD CAM IN LATCH ASY. OF ACB
G	EN1	021481	050678	D	PM	B13		S	1		T	D	CORE SPRAY PUMP FAILED TO START (1A)	CONTROL SWITCH HAD BROKEN POSITION STOP
G	EN1	033578	090680	L	PM	D02		S	1		T	D	"D" RHR PUMP VIBRATED OUTSIDE ASME CODE	WRONG REFERENCE DATA USED
G	FP1	017933	060677	U	PM	A19			1		T	T	"B" STANDBY LIQUID CONTROL SYS PUMP PKG LEAKAGE	PACKING DEGRADED DUE TO AGE AND WEAR
G	FP1	022504	091578	L	PM	B02		S	1		T	D	RHR PUMP 10-P-3C RENDERED INOPERABLE	CONTROL POWER FUSE HOLDER WAS BENT
G	FP1	027358	102079	L	PM	B13		S	1		T	T	RHR PUMP "C" FAILED TO START PROPERLY	LIMIT SWITCH NOT ADJUSTED PROPERLY
G	MO1	002168	101172	U	PM	C06		U	1		T	D	STBY LIQ CONT PUMP DIDNT DEVELOP REQD HEAD	IMPROPER VENTING/FILL OF SUCTION LINE
G	NM1	002015	060172	D	PM	B13		T	1		U	D	CORE SPRAY PUMP FAILED TO START	C3 FAILED - LNKGE TO AUX SWITCH BINDING
G	NM1	002016	060172	D	PM	B13		T	1		U	D	CORE SPRAY PUMP FAILED TO START	CB FAILED - BURNED CONT RELAY CONTACTS
G	NM1	010746	091774	F	PM	C05			1		T	D	#122 CNTMNT SPRAY FLOW 2600GPM VS. 3000GPM	2X4 PIECE OF WOOD WEDGED IN EYE OF PUMP
G	NM1	013016	061875	U	PM	B13		S	1		T	D	11 STANDBY LIQ CONT PUMP WOULD NOT START	POWER BRKR TRIGGER WAS NOT LATCHED
G	OC1	002253	080172	F	PM	B13		T	1		U	D	CONTAINMENT SPRAY PUMP FAILED TO START	DIRTY CONTACTS ON BRKR POSITION SWITCH
G	OC1	002305*	080172	U	PM	B13		U	2		U	D	BRKR FOR 1 STBY LIQ CONT PUMP RACKED OUT-OTHER PMP	WOULD NOT START - AUX CONT PREVENTED OPE
G	OC1	000217	061873	F	PM	B13		T	1		U	D	CONTAINMENT SPRAY PUMP 51C DID NOT START	BROKEN WIRE TO KEY LOCK SWITCH
G	OC1	010834	101874	F	PM	B13		T	1		T	D	CONTAINMENT SPRAY PUMP 51A FAILED TO START	START CIRCUIT FAILURE - TIME DELAY RELAY
G	OC1	012029	021175	F	PM	B00		R	1		T	U	CONTAINMENT SPRAY PMP 51A FAILD TO START IN AUTO	UNDER INVESTIGATION

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G	QC1	012330	030675	F	PM	B13		T	1		T	D	CONTAINMENT SPRAY PUMP 51A FAILED TO START IN AUTO	BRKR TRIP BAR FAILED TO RESET ON PREV TRP
G	QC1	014576	042376	D	PM	A19			1		N	U	INBOARD SEAL ON CORE SPRAY MZ01B CRACKD 3GPM LEAK	CARBON ROTATNG WASHR CRACKD CAUSE UNKNWN
G	QC1	016477	111176	F	PM	B13		T	1		T	D	CONTAINMENT SPRAY PUMP 51D DID NOT START	CB TRIP LATCH FAILED TO RESET
G	QC1	023118A	112678	F	PM	B13		T	1		T	D	CONTAINMENT SPRAY PUMP 51C FAILED TO START	EXCESS FRICTION IN POWER CIRCUIT BREAKERS
G	QC1	0231188	120278	F	PM	B13		T	1		T	D	CONTAINMENT SPRAY PUMP 51C FAILED TO START	EXCESS FRICTION IN POWER CIRCUIT BREAKERS
G	QC1	025827	041979	D	PM	B13		S	1		T	D	CORE SPRAY PUMP FAILED TO START ON SIGNAL (MZ01A)	FUSE FAILURE
G	QC1	027695	110379	D	PM	B03		U	1		T	D	CORE SPRAY BOOSTER PUMP DID NOT START, LOOSE FUSE	PERSONNEL MANIPULATING FUSE FOR TEST
G	PB2	021081	042978	L	PM	U01		U	2		N	D	UNIT 2 "B","D"RHR BLOCKED FOR 2 HRS.	OPERTR REMVD UNIT 2 INSTED OF UNIT 3 PMPS
G	PB3	012013	021675	U	PM	B13		S	1		T	D	STANDBY LIQUID CONTROL PUMP FAILED TO START	ONE PHASE TRIP DEVICE MARGINALLY ADJUSTED
G	PB3	019831	111477	U	PM	A07			1		N	T	STDBY LIQUID CONTROL PMP 3BP40 OUT OF SERVICE	REPLACE PACKING PREVNTV MAINTENANCE
G	PB3	020273	011378	U	PM	B13		S	1		T	T	STANDBY LIQUID CONT PUMP 3A DECLARED INOPERABLE	N2 ACCUM DEPRESS - CHGING VALVE FAILED OP
G	PI1	012441	031975	D	PM	B18			1		T	U	"A" CORE SPRAY PUMP TRIPPED ON START	FAULTY MOTOR WINDINGS - INSULATION
G	PI1	019593	100977	D	PM	B13		S	1		T	D	CORE SPRAY PUMP P-215B FAILED TO START	INCORRECT LOGIC CLSNG SCHEME FOR CIR BRKR
G	PI1	020884	032378	D	PM	B13		S	1		T	D	CORE SPRAY PUMP "A" DECLARED INOPERATIVE	LOOSE CONN ON SPRING CHARGING LIMIT SWTCH
G	PI1	031177	051380	D	PM	B13		T	1		T	D	CORE SPRAY PUMP P-215B FAILED TO AUTO START	BKR 152-607 EXPERIENCED A TRIP FREE OP.
G	QC1	002210	101972	D	PM	B13		S	1		T	D	1B CORE SPRAY PUMP FAILED TO START DURING TEST	IMP ADJ AUX CONT IN BREAKER NO. 1422
G	QC1	014539	032576	U	PM	C14			1		T	T	"B" SBLC SYS PUMP HAD DISCH PRESS FLUCTUATIONS	INTERNAL CHK VLVS WERE LEAKING
G	QC1	016904	120276	L	PM	B02		U	1		U	D	AIR LOCKD SUCT HEADR COMMON TO 1A RHR LOOP,DIESL C	RHR SER WTR PMP HAD AIR LINE CONN TO CASE
G	QC2	012799	041875	D	PM	B13		S	1		T	D	CORE SPRAY PUMP 2B FAILED TO AUTO START	LOOSE TERMINAL CONN ON CONT PANEL 902-33
G	VY1	016997	011877	L	PM	B13		S	1		T	D	"D" RHR PUMP WOULD NOT START	A LOOSE LEAD IN A BREAKER CAUSED FAILURE

PWR HPCI and CVC Pumps

For this analysis, the two systems are treated as a single pooled system. This allows for common cause shocks that affect both HPCI pumps and CVC pumps simultaneously. The two systems have already been treated separately, CVC with the alternating pumps and HPCI with the standby pumps. In these earlier analyses, the only common cause shocks considered were restricted to a single system. The exposure times used are calendar hours.

Rates are estimated for:

1. Failure to start, based on all faults

2. Failure to start, based on failures only

3. Failure to operate after starting, based on all faults

4. Failure to operate after starting, based on failures only.

Be sure to read the Application section in the main body of this report. The following computer printouts give the estimates and summaries of the relevant data.

PWR HPCI AND CVC PUMPS (POOLED)
FAILURE TO START
ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS
RATES ARE PER CALENDAR HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.140, .261, .395)
LAMBDA = (1.5E-08, 2.9E-06, 1.1E-05)
$LAMBDA_+$ = (9.8E-07, 5.5E-06, 1.3E-05)
OMEGA = (8.8E-10, 2.2E-07, 8.6E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
2	(2.1E-06, 1.3E-05, 3.3E-05)	(1.4E-06, 6.3E-06, 1.5E-05)	(.041, .187, .358)
3	(1.7E-06, 1.0E-05, 2.5E-05)	(1.2E-06, 5.6E-06, 1.4E-05)	(.048, .252, .455)
4	(1.4E-06, 8.4E-06, 2.1E-05)	(1.0E-06, 5.2E-06, 1.4E-05)	(.048, .266, .462)
5	(1.3E-06, 7.5E-06, 1.8E-05)	(9.7E-07, 5.0E-06, 1.3E-05)	(.044, .253, .451)
6	(1.2E-06, 6.9E-06, 1.7E-05)	(9.2E-07, 4.9E-06, 1.3E-05)	(.039, .228, .439)
7	(1.1E-06, 6.6E-06, 1.6E-05)	(8.9E-07, 4.8E-06, 1.3E-05)	(.033, .199, .423)
OVERALL	(1.1E-06, 8.4E-06, 3.3E-05)	(8.9E-07, 5.2E-06, 1.5E-05)	(.033, .252, .462)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(2.1E-07, 1.1E-06, 2.5E-06)		
3	(1.6E-07, 8.7E-07, 2.1E-06)	(2.4E-08, 4.1E-07, 1.2E-06)	
4	(1.3E-07, 7.8E-07, 1.9E-06)	(1.9E-08, 3.9E-07, 1.1E-06)	(3.8E-09, 2.8E-07, 9.3E-07)
5	(1.2E-07, 7.3E-07, 1.8E-06)	(1.6E-08, 3.7E-07, 1.1E-06)	(3.4E-09, 2.7E-07, 9.2E-07)
6	(1.1E-07, 7.0E-07, 1.7E-06)	(1.5E-08, 3.6E-07, 1.1E-06)	(3.3E-09, 2.7E-07, 9.2E-07)
7	(9.8E-08, 6.8E-07, 1.7E-06)	(1.3E-08, 3.6E-07, 1.1E-06)	(3.1E-09, 2.7E-07, 9.2E-07)
OVERALL	(9.8E-08, 7.8E-07, 2.5E-06)	(1.3E-08, 3.7E-07, 1.2E-06)	(3.1E-09, 2.7E-07, 9.3E-07)

PWR HPCI AND CVC PUMPS (POOLED)
FAILURE TO START
FAILURES ONLY, EXCLUDING COMMAND FAULTS
RATES ARE PER CALENDAR HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.002, .146, .458)
LAMBDA = (2.6E-07, 5.7E-07, 9.9E-07)
LAMBDA* = (4.9E-07, 1.6E-06, 3.2E-06)
OMEGA = (8.8E-10, 2.2E-07, 8.6E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
2	(1.3E-06, 6.6E-04, 3.7E-04)	(8.2E-07, 1.6E-06, 2.8E-06)	(.010, .137, .392)
3	(1.1E-06, 4.4E-04, 2.5E-04)	(7.0E-07, 1.4E-06, 2.4E-06)	(.013, .182, .442)
4	(9.4E-07, 3.3E-04, 1.9E-04)	(6.3E-07, 1.3E-06, 2.2E-06)	(.014, .200, .454)
5	(8.5E-07, 2.7E-04, 1.5E-04)	(5.9E-07, 1.2E-06, 2.1E-06)	(.015, .201, .465)
6	(8.0E-07, 2.2E-04, 1.2E-04)	(5.6E-07, 1.2E-06, 2.1E-06)	(.014, .196, .476)
7	(7.6E-07, 1.9E-04, 1.1E-04)	(5.4E-07, 1.2E-06, 2.0E-06)	(.013, .190, .500)
OVERALL	(7.6E-07, 3.3E-04, 3.7E-04)	(5.4E-07, 1.3E-06, 2.8E-06)	(.010, .196, .500)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(7.1E-09, 3.6E-07, 1.1E-06)		
3	(5.3E-09, 3.3E-07, 1.0E-06)	(1.8E-09, 2.6E-07, 9.3E-07)	
4	(4.4E-09, 3.2E-07, 1.0E-06)	(1.7E-09, 2.6E-07, 9.2E-07)	(1.2E-09, 2.4E-07, 8.9E-07)
5	(3.9E-09, 3.1E-07, 1.0E-06)	(1.6E-09, 2.5E-07, 9.2E-07)	(1.2E-09, 2.4E-07, 8.9E-07)
6	(3.6E-09, 3.0E-07, 1.0E-06)	(1.6E-09, 2.5E-07, 9.2E-07)	(1.2E-09, 2.4E-07, 8.8E-07)
7	(3.4E-09, 3.0E-07, 1.0E-06)	(1.5E-09, 2.5E-07, 9.1E-07)	(1.2E-09, 2.4E-07, 8.8E-07)
OVERALL	(3.4E-09, 3.2E-07, 1.1E-06)	(1.5E-09, 2.5E-07, 9.3E-07)	(1.2E-09, 2.4E-07, 8.9E-07)

PWR HPCI AND CVC PUMPS (POOLED)
FAILURE TO OPERATE, GIVEN START
ALL FAULTS - BOTH FAILURES AND COMMAND FAULTS
RATES ARE PER CALENDAR HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.082, .189, .316)
LAMBDA = (7.1E-07, 1.0E-05, 2.9E-05)
LAMBDA+ = (7.3E-10, 1.2E-07, 4.7E-07)
OMEGA = (8.8E-10, 2.2E-07, 8.6E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT RI	BETA FACTOR
2	(2.2E-09, 4.3E-07, 1.6E-06)	(9.8E-07, 1.0E-05, 2.9E-05)	(.000, .016, .241)
3	(1.6E-09, 3.1E-07, 1.2E-06)	(9.6E-07, 1.0E-05, 2.9E-05)	(.000, .016, .248)
4	(1.4E-09, 2.5E-07, 9.6E-07)	(9.5E-07, 1.0E-05, 2.9E-05)	(.000, .016, .250)
5	(1.2E-09, 2.2E-07, 8.2E-07)	(9.5E-07, 1.0E-05, 2.9E-05)	(.000, .016, .250)
6	(1.1E-09, 2.0E-07, 7.4E-07)	(9.4E-07, 1.0E-05, 2.9E-05)	(.000, .016, .249)
7	(1.0E-09, 1.8E-07, 6.8E-07)	(9.4E-07, 1.0E-05, 2.9E-05)	(.000, .016, .248)
OVERALL	(1.0E-09, 2.5E-07, 1.6E-06)	(9.4E-07, 1.0E-05, 2.9E-05)	(.000, .016, .250)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(1.6E-09, 2.4E-07, 8.8E-07)		
3	(1.4E-09, 2.3E-07, 8.7E-07)	(9.8E-10, 2.3E-07, 8.6E-07)	
4	(1.3E-09, 2.3E-07, 8.7E-07)	(9.7E-10, 2.3E-07, 8.6E-07)	(9.0E-10, 2.2E-07, 8.6E-07)
5	(1.2E-09, 2.3E-07, 8.7E-07)	(9.6E-10, 2.3E-07, 8.6E-07)	(9.0E-10, 2.2E-07, 8.6E-07)
6	(1.2E-09, 2.3E-07, 8.7E-07)	(9.5E-10, 2.3E-07, 8.6E-07)	(9.0E-10, 2.2E-07, 8.6E-07)
7	(1.2E-09, 2.3E-07, 8.7E-07)	(9.5E-10, 2.3E-07, 8.6E-07)	(9.0E-10, 2.2E-07, 8.6E-07)
OVERALL	(1.2E-09, 2.3E-07, 8.8E-07)	(9.5E-10, 2.3E-07, 8.6E-07)	(9.0E-10, 2.2E-07, 8.6E-07)

PWR HPCI AND CVC PUMPS (POOLED)
FAILURE TO OPERATE, GIVEN START
FAILURES ONLY, EXCLUDING COMMAND FAULTS
RATES ARE PER CALENDAR HOUR
TRIPLE OF NUMBERS SHOWS (LOWER BOUND, POINT ESTIMATE, UPPER BOUND)
LOWER AND UPPER BOUNDS FORM 90 PERCENT INTERVAL

P = (.001, .092, .299)
LAMBDA = (3.8E-07, 8.4E-06, 2.5E-05)
LAMBDA$_+$ = (2.6E-07, 1.1E-06, 2.5E-06)
OMEGA = (8.8E-10, 2.2E-07, 8.6E-07)

SYSTEM SIZE M	SHOCK RATE MU	RATE FOR SPECIFIC COMPONENT R1	BETA FACTOR
2	(1.1E-06, 8.2E-04, 4.5E-04)	(1.1E-06, 9.2E-06, 2.6E-05)	(.001, .025, .218)
3	(8.5E-07, 5.5E-04, 3.0E-04)	(9.7E-07, 9.0E-06, 2.6E-05)	(.001, .028, .268)
4	(7.1E-07, 4.1E-04, 2.2E-04)	(8.9E-07, 8.9E-06, 2.6E-05)	(.001, .029, .295)
5	(6.3E-07, 3.3E-04, 1.8E-04)	(8.4E-07, 8.9E-06, 2.6E-05)	(.001, .028, .309)
6	(5.7E-07, 2.7E-04, 1.5E-04)	(8.1E-07, 8.8E-06, 2.6E-05)	(.001, .028, .316)
7	(5.3E-07, 2.3E-04, 1.3E-04)	(7.9E-07, 8.8E-06, 2.6E-05)	(.001, .027, .320)
OVERALL	(5.3E-07, 4.1E-04, 4.5E-04)	(7.9E-07, 8.9E-06, 2.6E-05)	(.001, .028, .320)

SYSTEM SIZE M	RATE FOR SET OF K SPECIFIC COMPONENTS R2	R3	R4
2	(3.5E-09, 2.8E-07, 9.4E-07)		
3	(2.7E-09, 2.7E-07, 9.2E-07)	(1.2E-09, 2.3E-07, 8.7E-07)	
4	(2.4E-09, 2.6E-07, 9.1E-07)	(1.2E-09, 2.3E-07, 8.7E-07)	(9.6E-10, 2.3E-07, 8.6E-07)
5	(2.2E-09, 2.6E-07, 9.0E-07)	(1.1E-09, 2.3E-07, 8.7E-07)	(9.6E-10, 2.3E-07, 8.6E-07)
6	(2.0E-09, 2.5E-07, 9.0E-07)	(1.1E-09, 2.3E-07, 8.7E-07)	(9.5E-10, 2.3E-07, 8.6E-07)
7	(1.9E-09, 2.5E-07, 9.0E-07)	(1.1E-09, 2.3E-07, 8.7E-07)	(9.5E-10, 2.3E-07, 8.6E-07)
OVERALL	(1.9E-09, 2.6E-07, 9.4E-07)	(1.1E-09, 2.3E-07, 8.7E-07)	(9.5E-10, 2.3E-07, 8.6E-07)

ALL FAILURES TO START IN PWR HPCI AND CVC PUMPS

PLANT	CRIT. HOURS	CALEND. HOURS	POP	NUMBER OF INDIV. FAULTS FAILRS/COM FLTS	NUMBER OF NONLETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY NONLETHAL SHOCKS FAILRS/COM FLTS	NUMBER OF LETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY LETHAL SHOCKS FAILRS/COM FLTS
AR1	33594	53952	3	0 / 0	1 / 0	1 / 0	0 / 0	0 / 0
CR3	17695	32544	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DB1	13042	26808	2	0 / 1	1 / 1	1 / 1	0 / 0	0 / 0
DE1	45079	65328	3	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
DE2	37558	60384	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DE3	36816	53232	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RS1	29290	52968	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI1	31732	42192	3	0 / 3	1 / 0	1 / 0	0 / 0	0 / 0
TI2	3399	8784	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AR2	7068	15984	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	38451	52464	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC2	26811	33624	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FC1	47570	62712	6	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MI2	30580	43464	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
MY1	55878	69600	4	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
PA1	38960	76704	5	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
SL1	26229	38952	6	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
BV1	13775	38520	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC1	37510	49992	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
DC2	16811	22464	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	63506	76704	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	37770	64536	6	0 / 0	0 / 1	0 / 2	0 / 0	0 / 0
IP3	26443	39336	6	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
JF1	16272	27576	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KE1	46125	57600	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA1	15859	21840	3	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
NA2	1724	2664	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	46464	59904	6	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	44184	50760	6	0 / 2	0 / 0	0 / 0	0 / 0	0 / 0
PT1	62073	76704	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

PT2	64363	73104	5	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	58079	76704	6	0 / 8	0 / 0	0 / 0	0 / 0	0 / 0
RD2	60180	76704	6	1 / 1	0 / 1	0 / 2	0 / 1	0 / 3
SA1	16489	33360	5	1 / 1	0 / 1	0 / 3	0 / 0	0 / 0
SE1	542	2112	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SD1	56392	76704	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	42519	72336	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	35584	66360	6	0 / 0	0 / 1	0 / 1	0 / 0	0 / 0
TR1	21998	42048	7	0 / 3	0 / 0	0 / 0	0 / 0	0 / 0
TU3	52965	69672	7	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0
TU4	46080	64056	7	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
YR1	53515	76704	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	42451	63864	5	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	37666	59352	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	1537087	2308416	209[A]	6 / 26	3 / 8	3 / 12	0 / 1	0 / 3

A. THIS COUNTS SHARED PUMPS ONLY ONCE.

ALL FAILURES TO OPERATE, GIVEN START, IN PWR HPCI AND CVC PUMPS

PLANT	CRIT. HOURS	CALEND. HOURS	POP	NUMBER OF INDIV. FAULTS FAILRS/COM FLTS	NUMBER OF NONLETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY NONLETHAL SHOCKS FAILRS/COM FLTS	NUMBER OF LETHAL SHOCKS FAILRS/COM FLTS	PUMPS AFFECTED BY LETHAL SHOCKS FAILRS/COM FLTS
AR1	33594	53952	3	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CR3	17695	32544	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
OB1	13042	26808	2	3 / 0	0 / 1	0 / 1	0 / 0	0 / 0
OE1	45079	65328	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
OE2	37558	60384	3	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
OE3	36816	53232	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RS1	29290	52968	3	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TI1	31732	42192	3	1 / 0	0 / 1	0 / 2	0 / 0	0 / 0
TI2	3398	8784	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
AR2	7068	15984	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
CC1	38451	52464	6	5 / 2	0 / 0	0 / 0	0 / 0	0 / 0
CC2	24811	33624	6	4 / 0	0 / 0	0 / 0	0 / 0	0 / 0
FC1	47570	62712	6	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0
MI2	30580	43464	6	3 / 0	1 / 0	1 / 0	0 / 0	0 / 0
MY1	55878	69600	4	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PA1	38960	76704	5	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SL1	26228	38952	6	6 / 0	0 / 0	0 / 0	0 / 0	0 / 0
BV1	13775	38520	5	4 / 3	1 / 1	1 / 1	0 / 0	0 / 0
DC1	37510	49992	5	3 / 1	0 / 0	0 / 0	0 / 0	0 / 0
DC2	16811	22464	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
HN1	63506	76704	5	5 / 0	0 / 0	0 / 0	0 / 0	0 / 0
IP2	37770	64536	6	11 / 0	0 / 1	0 / 3	0 / 0	0 / 0
IP3	26443	39336	6	8 / 0	0 / 0	0 / 0	0 / 0	0 / 0
JF1	16271	27576	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
KE1	46125	57600	5	3 / 2	0 / 0	0 / 0	0 / 0	0 / 0
NA1	15859	21840	3	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
NA2	1724	2664	3	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR1	46464	59904	6	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PR2	44184	50760	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
PT1	62073	76704	5	4 / 0	0 / 0	0 / 0	0 / 0	0 / 0

PT2	64363	73104	5	11 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RG1	58078	76704	6	3 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RO2	60180	76704	6	0 / 0	0 / 2	0 / 3	0 / 0	0 / 0
SA1	16488	33360	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SE1	542	2112	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SO1	56392	76704	5	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU1	42519	72336	6	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
SU2	35584	66360	6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TR1	21998	42048	7	1 / 0	0 / 2	0 / 0	0 / 0	0 / 0
TU3	52966	69672	7	4 / 0	0 / 1	0 / 1	0 / 0	0 / 0
TU4	46080	64056	7	2 / 0	0 / 0	0 / 0	0 / 0	0 / 0
YR1	53515	76704	6	1 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI1	42451	63864	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
ZI2	37666	59352	5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
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ALL	1537087	2308416	209[A]	95 / 9	2 / 7	2 / 11	0 / 0	0 / 0

A. THIS COUNTS SHARED PUMPS ONLY ONCE.

ALL FAULTS IN PWR HPCI AND CVC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
B	AR1	013015	070775	G	PM	B01	C		1	N	D		P36C M/U PUMP STARTED AND IMMED TRIPPED, PUMP FRZN	RAN WITH NO SUCTION,INCORRECT VLV LINE-UP
B	AR1	016195	100376	G	PM	D08			1	N	T		P36B STOPPED DUE TO OVR-CURRENT AND LOSS OF PRESS	EXCESSIVE INTERNAL COMPONENT WEAR
B	DB1	012374	091777	G	PM	A19			1	N	D		MAKEUP PUMP 1-2 HAD OIL LEAK ON OIBD BRNG END PLT	O-RING ON END PLATE DID NOT FORM ADEQ SL
B	DB1	021858	061678	G	PM	D12			1	T	T		HORIZONTAL VIBRATION ON HPCI PUMP 1-1	PUMP WAS MISALIGNED DUE TO LOOSE MOUNTS
B	DB1	025525A	010379	G	PM	C04	U		1	T	D		HPI PUMP 1-1 FAILED TO DEVELOP SUFFICIANT RECIRC	HEAT TRACE UNABLE TO MAIN LINE ABOVE FREZ
B	DB1	025525B	010379	G	PM	U04	U		1	T	D		HPI PUMP 1-2 MAY NOT HAVE HAD SUFF. RECIRC	HEAT TRACE UNABLE TO MAIN LINE ABOVE FREZ
B	DB1	025603	032979	G	PM	C09			1	N	D		MAKE UP PUMP 1-1 DEVELOPED VIB AND DECRE PERFORM.	FOREIGN DEBRIS FAILED WEARING RING
B	DB1	027859	111279	G	PM	B05	S		1	T	D		HPI PUMP 1-1 FAILED TO START	FACTORY DEFECT IN CONTROL CIRCUIT WIRING
B	DB1	031610	062380	G	PM	U01	C		1	N	D		HPI PUMP 1-1 BEARING THERMOCOUPLE WELLS BROKEN	ASSUMED TO BE STEPPED ON
B	DE1	014806C	012876	G	PM	B02	U		1	T	D		HIGH PRESSURE INJECTION PUMP - INOPERABLE (1A)	INCORRECT SUBSTITUTE BREAKER INSTALLED
B	DE2	031916	071380	G	PM	D21			1	N	T		2B HPI PUMP REMOVED FROM SERVICE	BAD BEARING CAUSE NOT STATED
B	DE2	033125	072680	G	PM	D18	R		1	N	U		2B HPI PUMP DECLARED INOPERABLE,DEVELOPED HOT BEAR	UPWARD PRESSURE OF MOTOR AGAINST UP BEAR.
B	RS1	014502	032376	G	PM	D00			1	N	U		HPCI P238A TRIPPD OFF LINE WHEN AT 100% POWER	NO CAUSE COULD BE FOUND THRU TESTING
B	TI1	011016	101074	G	PM	B02	S		1	T	D		MAKEUP PUMP 1A TRIPPED ON MANUAL ACTUATION	WRONG LUG USED TO CONN FOR CBL TO MTR WDG
B	TI1	011015	101774	G	PM	B13	S		1	T	D		MAKEUP PUMP 1C FAILED TO START - AUTOMATIC	WESTINGHSE ACB HAD DISLGD TRIP LTCH SPRNG
B	TI1	012103	010375	G	PM	B13	S		1	T	D		HIGH PRESS INJ PUMP MU-P1C FAILED TO START	LOOSE TERMINATION ON BRKR RELEASE
B	TI1	014220	021776	G	PM	B06	C		1	T	D		"A" MAKEUP/PURIF PMP STARTED WITH IMPROPR VALV L/U	PMP FAILURE DUE TO INAD PROCEDRES/PERSONL
B	TI1	020997*	031878	G	PM	D13	U		2	T	D		THE 1A & 1C MAKEUP PMPS TRIPPED ON XFER TO SITE PR	MALFUNC TIME DELAY RELAY IN LOW L.O. CKT
B	TI1	025503	021779	G	PM	D18			1	T	T		HPI PUMP MU-P-1C TRIPPED ON OVERLOAD	FAILED LEAD INSIDE PUMP MOTOR
C	CC1	013189	080175	G	PM	A19	R		1	U	U		#13 CHARGING PUMP RELEASED GAS ACT TO AUX BLDG	PLUNGER PKG LKG (UTEX INDUS. PART# SF194)
C	CC1	013389	091175	G	PM	A19	R		1	U	U		#13 CHG PUMP RELEASED GAS ACT FROM UA-1 MAIN VENT	PLUNGER PACKING LEAKED EXCESSIVELY
C	CC1	014754	050476	G	PM	D00	S		1	N	U		#13 CHARGN PUMP TRIPPD DUE TO BREAKER OPENING	CAUSE FOR OPENING OF BKR. UNKNOWN
C	CC1	018485	072977	G	PM	A19	R		1	N	T		#12 CHARGING PUMP REMOVED FROM SERVICE	REPAIR SLOWLY INCREASING PACKING LEAK
C	CC1	019698	111377	G	PM	A19	R		1	N	T		#12 CHG PUMP S/D AND ISOLATED	EXCESSIVE PACKING LEAKAGE, PACKING FAILED
C	CC1	026718A	080679	G	PM	D13	S		1	N	T		#12 CHARGING PUMP TRIPPED ON LOW SUCITON PRESSURE	FAULTY PRESSURE INDICATING SWITCH

ALL FAULTS IN PWR HPCI AND CVC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
C	CC1	0267188	080679	G	PM	A19			1	N	T		#11 CHARGING PUMP ISOLATED DUE TO LEAK	PACKING FAILED
C	CC2	017049	012177	G	PM	C14			1	N	T		FLOW FROM #21 CHG PMP DECREASED TO ABOUT 39 GPM	INVEST REVEALED TWO DISCH VLVS BROKEN
C	CC2	023173*	121278	G	PM	A19			2	N	T		21 AND 22 CHARGING PUMPS HAD EX PRI PACKING LEAKS	PACKINGS REACHED EOL SIMULTANEOUSLY
C	CC2	027373	102779	H	PM	D19			1	N	T		HPSI PUMP "A" FAILED,REQUIRING SECURING THE PUMP	MECHANICAL SEALS FAILED ON #22 HPCI PUMP
C	FC1	012513	040375	G	PM	B09		S	1	T	T		CHARGING PUMP CH-1C FAILD TO START	DIRTY TIMING RELAY CONTACTS
C	FC1	032766	092680	G	PM	D19		S	1	N	T		"A" CHARGING PUMP BECAME INOPERABLE	PACKING COOLING WATER PUMP FAILED
C	MI2	014602	050276	G	PM	C19			1	T	T		"A"CHARGING PUMP NO FLOW ON AUTOMATIC START	GROSS PACKING LEAKS
C	MI2	017374	121276	G	PM	D00			1	N	U		"C" CHARGING PMP TAGGD OUT DUE TO EXCESSIVE NOISE	UNKNOWN
C	MI2	030796	031080	G	PM	A19			1		T		CHARGING PUMP PLACED OUT OF SERVICE	PACKING FAILED,NATURAL END OF LIFE
C	MI2	031945	070380	H	PM	D06	C		1	T	D		"A" HPCI PUMP SEIZED	PROCEDURE DID NOT REQUIRE MIN FLOW VLV OP
C	MY1	002322	120272	H	PM	B02	U		1	T	D		HPSI P-145 SUPPLIED BY "A" DG DID NOT START	GROUNDING BLOCK NOT REMOVED FROM CKT BKR
C	MY1	021039	030278	G	PM	D02			1	T	T		1A CHARGING PMP STARTD FOR VIBRATN TEST--HI TEMP.	LOCKN PIN NOT INSTLLD TO BEARING
C	PA1	010659	071174	H	PM	C04			1	T	D		HPSI P66A TESTED UNSAT SHUTOFF HEAD NOT DEVELOPD	6TH STAGE IMPELLOR MOVED ON SHAFT
C	PA1	014719	042176	G	PM	B09			1	T	T		CHARGING PUMP P55-A WOULD NOT START PROPERLY	PLUGGED OIL FILTER
C	PA1	021117	041778	G	PM	B13		S	1	N	D		CHARGING PUMP P-55B WOULD NOT START	FAULTY CONTROL COIL IN CIRCUIT BREAKER
C	PA1	022913	103178	G	PM	A19			1	N	T		CHR PUMP P-55C TAKEN OUT OF SERVICE	LEAKING SEALS
C	SL1	017394A	022077	G	PM	D00	R		1	N	U		B CHG PMP SEAL LUBE WTR PMP FAILED DURING R/X S/U	MODEL SD11,TYPE 102,STYLE CZOOV
C	SL1	017394B	022077	G	PM	D00	R		1	N	U		A CHG PMP SEAL LUBE WTR PMP FAILED DURING R/X S/U	MODEL SD11 TYPE 102 PART#78 15157
C	SL1	017393	022677	G	PM	C00	R		1	N	U		DURING POWER OPS,A CHRGNG PMP SEAL LUBE WTR FAILED	FAILD TO DELIVER SUFFICIENT FLOW
C	SL1	023658	090278	G	PM	A16	R		1	M	T		CHR PUMP 1A FOUND TO HAVE SMALL CRACK IN BLOCK	CAUSE OF CRACK IS UNKNOWN
C	SL1	022649	100278	G	PM	B13	S		1	N	D		1B CHARGING PUMP FAILED TO START	ELEC INTER READ O SUCTION PRESSURE
C	SL1	025595	031679	G	PM	A16	R		1	N	T		1C CHARGING PUMP DEVELOPED CRACKED PUMP CASING	SUCTION CAVITATION & VIBRATION
C	SL1	032587A	082880	G	PM	A00	R		1	M	U		SEAL WATER LEAK DEVELOPED IN 1B CHR PUMP	CAUSE NOT STATED
C	SL1	032587C	082880	G	PM	B00	S		1	N	T		1A CHR PUMP STARTED THEN APPARENTLY STOPPED	FAILED SEAL WATER PUMP
W	BV1	016751A	121576	G	PM	A14	R		1	N	T		1C CHARGNG PMP LEAKING AT SPEEDINC. GEAR CASING	TURF FAILURE OF L.O. COOLER

ALL FAULTS IN PWR HPCI AND CVC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	BV1	0167518	121576	G	PM	A14		R	1		N	T	1B CHARGNG PMP LEAKING AT GEAR CASING	TURF FAILURE OF L.O. COOLER
W	BV1	018348	070577	G	PM	D15			1		N	U	1B CHARGING PUMP TRIPPED ON PHASE OVERCURRENT	PUMP SHAFT CRACKED AT BALANCE DRUM NUT
W	BV1	021356A	041678	G	PM	D09		S	1		N	T	1B CHARGN/SI PUMP HI BEARING TEMP ALARM	PLUGGED OIL PUMP COOLERS-WATER SIDE
W	BV1	0213568	041678	G	PM	D09		S	1		N	T	1C CHARGE/SI PMP HI BEARING TEMP ALARM PLGGD COOL	RIVER WATER STRAINERS TORN ALLOWING DEBRI
W	BV1	021646	042178	G	PM	D01		S	1		N	D	1C CHG PUMP TRIPPED, NO BACK-UP WAS AVAILABLE	OPERATOR MADE IMPROPER ELEC LINE-UP
W	BV1	028145	010379	G	PM	C14			1		N	T	1C CHARGING PUMP HAD LOW DISCHAGE PRESSURE	FAULTY ROTATING ELEMENT
W	BV1	026841	081679	G	PM	D02	C		1		T	D	1C CHARGING PUMP BECAME INOPERABLE	FAILED BEARING DUE TO A COOLING VLV SHUT
W	BV1	032789	091780	G	PM	D02	U		1		T	D	1C HIGH HEAD CHARGING PUMP BEARING TEMP INCREASED	CHECK VALVES INSTAL BACKWARDS IN COOL H2O
W	DC1	017650	040777	G	PM	D15	R		1		N	D	1W CENT CHG PUMP AMMTR PEGGED, PUMP DEENERGIZED	BROKEN SHAFT.CLEAN BRK UNDR 11TH STG IMP
W	DC1	017670	041877	G	PM	D02	S		1		N	D	"W" CHARGN PMP HIGHER THAN NORMAL CASING TEMPERATR	RAG STUCK IN RECIRC LINE DURIN ROTOR REPL
W	DC1	017769	051777	G	PM	D15	R		1		N	D	EAST CENT CHG PMP BRK BET 3RD & 4TH STG IMPELLERS	BREAK APPEARED TO BE A FATIGUE FAILURE
W	DC1	031811	070380	G	PM	D15	R		1		N	D	TRAIN B CENTRIFUGAL CHR PUMP FAILED WHILE OPER.	SHAFT BROKE
W	HN1	014163	012476	G	PM	A19			1		N	T	EXCESSIVE SEAL LEAKAGE ON 1A CENT CHARGING PUMP	OUTBD SEAL HAD "O" RING FAILURE
W	HN1	017569	040477	G	PM	C20			1		N	T	"A" CHGNG PUMP INDICATIONS POINTED TO FAULTY OPS	DISASSY REVEALED CRKS UNDER PRESS RED SLV
W	HN1	017689	042677	G	PM	A05			1		M	D	1A CHG PMP DEVELOPED SMALL WEEP ON SUCT MECH SEAL	SLIGHT POROSITY BTWN SL SPLY PSG & SL SUR
W	HN1	017688	042877	G	PM	D20			1		N	T	1A CHARGING PMP AXIAL MISALIGNMNT OF MTR TO PUMP	EXCESS THRUST WIPED MOTOR BEARING RAN 20M
W	HN1	021329	040378	H	PM	C14			1		M	U	"A" HPSI PMP DEVELOPED UNUSUAL DRAG DURING MAINT	INSPECTION DISCLSD CRKD WR RNGS & BSHNGS
W	IP2	010282	051074	H	PM	B09	U		2		N	T	#23 & #21 HPSI PUMP STARTED ONLY DEVELOP 700# PRS	BORIC ACID LEAKAGE CAUSD SUCTION BLOCKAGE
W	IP2	013170*	072275	G	PM	A19	R		1		N	D	2 CHG PMPS REMOVED FROM SERVICE	EXCSV PLUNGER SEAL LEAKAGE
W	IP2	013299*	082775	G	PM	A19	R		1		N	D	2 CHG PMPS REMOVED FROM SERVICE	EXCSV PLNGR SEAL LKG.- VAR SPD 98GPM
W	IP2	013300*	082975	G	PM	A19	R		1		N	D	2 CHG PMPS REMOVED FROM SERVICE	EXCSV PLNGR SEAL LKG - PSBLE DESIGN MOD
W	IP2	013739A	110575	G	PM	A16	P		1		N	D	NO. 23 CHG PUMP REMOVED FROM SERVICE	LEAKING HEAD GASKET - TYPE QX-300 QUNTPLX
W	IP2	013739B	110575	G	PM	A19	R		1		N	D	NO. 22 CHG PUMP REMOVED FROM SERVICE	EXCSV PLNGR SEAL LKG - TYPE QX-300 QUNTPX
W	IP2	013850	120375	G	PM	A16	R		1		N	D	NO. 21 CHG PUMP REMOVED FROM SERVICE	LKG HEAD GSKT - TYPE GX-300 QUINTUPLEX
W	IP2	014003A	121875	G	PM	A16	R		1		N	D	NO. 21 CHG REMOVED FROM SERVICE	PIN HOLE LEAK IN FLUID HEAD

ALL FAULTS IN PWR HPCI AND CVC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	IP2	0140038	121875	G	PM	A16		R	1	N	D		NO. 23 CHG REMOVED FROM SERVICE	LARGE LEAK IN FLUID HEAD
W	IP2	015920*	080576	H	PM	C03		N	3	T	D		ALL 3 SAFETY INJ PUMPS RUN APPX 10 MIN W/O SUCTION	CMN PUMP SUCTION VLV (846) NOT OPEN
W	IP2	019236	052677	G	PM	C15			1	N	U		#22 CHG PUMP DEVELOPED LOUD NOISE - LOST DISCH PRS	FLUID DRIVE CPLNG FOUND BROKEN
W	IP2	021706	060278	H	PM	D21			1	T	T		EXCESS OIL FROM SI PUMP NO. 22 THRUST BEARING	THRUST COLLAR AND SHOES FAILED, REPLACED
W	IP2	023580	121478	G	PM	A16		R	1	M	T		CH. PUMP #22 HAD LEAKAGE AROUND STUFF BOX GASKET	FOUND CRACK IN FLUID HEAD AND CYL. WALL
W	IP3	016944	011277	H	PM	B13		S	1	N	D		#33 SI PMP FAILD TO START FROM SIS#PLANT TRIP 100%	TD RELAY IN START CKT FAILD MODEL 2412PC
W	IP3	017878	040477	H	PM	C14			1	R	T		NO. 31 SAFTY INJ PMP HAD GRAD DETERATN OF FLD DUPT	WORN INTERNALS - HIGH HEAD TYPE JTCH
W	IP3	019265	092577	G	PM	A16		R	1	N	U		#32 CHG PUMP DEVELOPED LEAK IN HEAD - TAKEN OFF-LN	HAIR-LINE CRACK IN HEAD - 98 GPM, QX-300
W	IP3	019264	093077	G	PM	A19		R	1	N	U		#33 CHG PUMP TAKEN OUT OF SERVICE	EXCSV SEAL LEAKAGE - TYPE QX-300 QUINTPLX
W	IP3	019262	100177	G	PM	A19		R	1	N	U		#31 CHG PUMP TAKEN OUT OF SERVICE	EXCSV SEAL LEAKAGE - TYPE QX-300 QUINTPLX
W	IP3	020122	121677	G	PM	A19		R	1	N	U		#33 CHG PUMP REMOVED FROM SERVICE	EXCSV SEAL LEAKAGE - 98GPM TYPE QX-300
W	IP3	021359	041678	G	PM	A19		R	1	N	U		#31 CHG PUMP REMOVED FROM SERVICE	EXCSV SEAL LEAKAGE - QX-300 QUINTUPLEX
W	IP3	022877	102778	G	PM	A14		R	1	N	T		LEAKAGE OBSERVED FROM NO. 31 CHARING PUMP	LEAK WAS FOUND IN PLUNGER
W	IP3	025232	020579	G	PM	A19		R	1	N	T		# 32 CHARGING PUMP DISCOVERED LEAKING	FAILED PLUNGER AND PACKING
W	KE1	019311	100277	G	PM	D18		R	1	N	D		FLOW FROM OPERATING CHG PMP WAS LOST DURING OPERTN	BROKEN BELT ON VARI-DRIVE UNIT
W	KE1	019643	110777	G	PM	D18		R	1	N	D		FLOW FROM OPERATING CHG PMP WAS LOST DURING OPER	BROKEN BELT ON VARI-DRIVE UNIT
W	KE1	022237	080978	G	PM	C13		S	1	N	T		CCP OPERATED ONLY AT HIGH SPEED	FAILED TRANSISTOR IN HAND CONTROL STATION
W	KE1	022540	091878	G	PM	A16			1	N	T		LEAK DEVELOPED ON CCP BETWEEN DIS. PIPE AND BLOCK	CRACK CAUSED BY OPERATING STRESS
W	KE1	030562	021180	G	PM	D13		S	1	N	T		CHARGING PUMP STOPPED WHEN CONTROL SW PLACED AUTO	STICKING CONTACT
W	NA1	022033	071778	G	PM	D02			1	N	D		CHP PUMP 1C BECAME INOPERABLE	IMPROPERLY ASSEMBLED SEAL ASSEMBLY
W	NA1	025716	040879	G	PM	U01	U		1	N	D		1A618 OOS FOR MAINT, 1C FEEDER BRKR NOT RACKED IN	IMPROPER TAGOUT PROCEDURE
W	NA1	027248	092879	G	PM	C00			1	T	U		CHARGING PUMP 1-CH-P-1A DID NOT FUNCTION	CAUSE NOT STATED
W	PR1	017619	041177	H	PM	D04			1	T	D		#12 SAFTY INJ PMP #7IMPELLR MOVED AXIALLY ON SHAFT	ABNORMAL PRESSURE DISTRBTION ACROSS IMPLR
W	PR1	018907	062877	G	PM	D13			1	N	U		CHARGING PUMP FAILED	CAPSCREW FAILURE IN VARIDRIVE UNIT
W	PR1	026014	040879	H	PM	B00			1	T	U		#11 SAFETY INJECTION PUMP FAILED TO START IN AUTO	UNKNOWN CAUSE, EVENT COULD NOT BE REPEATED

ALL FAULTS IN PWR HPCI AND CVC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	PP2	030733	031280	G	PM	B13	S		1		N	D	NO. 22 CHR PUMP MOTOR BKR KEPT TRIPPING	BREAKER FAILURE, BKR REPLACED
W	PP2	031631	061580	G	PM	B13	S		1		N	D	NO. 23 CHR PUMP STARTED AND SOON SHUTDOWN	AIR LEAKS IN SPEED CONTROL UNIT
W	PT1	016772*	030876	G	PM	D18	R		2		N	T	CHARGING PUMPS "B" AND "C" FAILED	BROKEN VARIDRIVE BELTS - VARIBELT NO. 842
W	PT1	016709	123076	G	PM	A19			1		N	T	C CHRGNG PMP OOS DUE TO PLUNGER LEAKAGE	PACKNG WEAR AJAX IRON WORKS TYPE T-125
W	PT1	027043	091279	G	PM	C16	R		1		U	D	THE 1-P2B CHR PUMP FOUND TO HAVE CRACKED CYL BLOCK	PRESSURE SPIKING FOLLOWING H2 SEPARATION
W	PT2	017248A	022176	G	PM	A19	R		1		N	T	2P2C CHARGING PUMP TAKEN OUT OF SERVICE	REPAIR PLUNGER LEAKAGE
W	PT2	017248B	022176	G	PM	D18	R		1		N	D	2P2B CHARGING PUMP FAILED	BROKEN VARIDRIVE BELT - VARIBELT NO. 842
W	PT2	016154A	092076	G	PM	A19	R		1		N	T	"C" CHARGING PUMP TAKEN OUT OF SERVICE	REPAIR MINOR PLUNGER LEAKAGE
W	PT2	016154B	092076	G	PM	D18	R		1		N	D	"B" CHARGING PUMP FAILED	BROKEN VARIDRIVE BELT - VARIBELT NO. 842
W	PT2	020461A	022177	G	PM	A19	R		1		N	T	2P2C CHARGING PUMP TAKEN OUT OF SERVICE	REPAIR PLUNGER LEAKAGE
W	PT2	020461B	022177	G	PM	D18	R		1		N	D	2P2B CHARGING PUMP FAILED	BROKEN VARIDRIVE BELT - VARIBELT NO. 842
W	PT2	020713D	040677	G	PM	C04	R		1		U	T	CHR PUMP "C" DISCOVERED TO HAVE CYC BLOCK CRACK	PULSATIONS CAUSED CRACKING
W	PT2	017722	042077	G	PM	C00			1		N	U	CHRGNG PMP UNABLE TO DELIVR SUFFCNT FLOW	NOT YET DETERMINED INVESTIGATIONS CONT
W	PT2	017839	051677	G	PM	B21			1		N	U	2P2B CHRGNG PMP OOS DUE FOR INSPECTION OF NOISY BR	BRNG FOUND SERVICEABLE
W	PT2	020713B	022878	G	PM	C04	R		1		M	T	CHR PUMP "B" DICCOVERED TO HAVE A CYL BLOCK CRACK	INSTLLTN OF PULSATION DAMPNERS PLANNED
W	PT2	020713C	030178	G	PM	C04	R		1		M	T	CHR PUMP "C" DISCOVERED TO HAVE A CYL BLOCK CRACK	INSTLLTN OF PULSATION DAMPNERS PLANNED
W	PT2	020974	031378	G	PM	D18	R		1		N	T	A CHRGING PMP OOS TO REPLACE BELT	BROKEN VARIDRIVE BELT
W	RG1	001037	061173	H	PM	B13	T		1		T	D	SAFETY INJECTION PUMP 1C FAILED TO START	RENT OPERATOR ARM ON THE CELL SWITCH
W	RG1	010046	040674	H	PM	B13	T		1		T	D	1C SAFETY INJECTION PUMP FAILED TO START MANUALLY	PREMATURE CLOSING OF CB TRIP BAR
W	RG1	010664	080774	H	PM	B13	T		1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 16	MAY BE FAULTY LOCKOUT INTERLOCK
W	RG1	012136A	020575	H	PM	B13	T		1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 15	REP WEAK SPRING AND TIGHTENED WIRE IN CB
W	RG1	012136B	020675	H	PM	B13	T		1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 16	REP WEAK SPRING AND TIGHTENED WIRE IN CB
W	RG1	012397	021875	H	PM	B13	T		1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 16	MECH BINDING ON LOCKOUT SOLENOID PLUNGER
W	RG1	015716	010377	H	PM	B13	T		1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 14	WEAK SPRING IN SECONDARY CONTACT ASSY
W	RG1	018225	061977	G	PM	D18	R		1		N	T	"C" CHARGING PUMP VARIDRIVE FOUND SMOKING	BELTS REPLACED - VARIDRIVE PART 84-2

ALL FAULTS IN PWR HPCI AND CVC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	RG1	018244	062977	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 14	NO APPARENT CAUSE FOR CB FAILURE
W	RG1	025064	010479	G	PM	A16			1		N	T	'A' CHARGING PUMP FOUND LEAKING	BLOCK REPLACED,HIGH HOOP STRESSES
W	RG1	025065	010479	G	PM	C18		R	1		N	T	'B' CHARGING PUMP SPEED CONTROL NOT OPERATING PROP	VARIDRIVE BELT SLIPPING AT LOW SPEEDS
W	RO2	000184*	070973	H	PM	B02		U	2		U	D	SAFTY INJECTION PMPS "B"&"C" TRIPPD ON MANUAL STAR	INSTANTNS TRIP SETTINGS WERE SET AT MIN.
W	RO2	018138*	060777	G	PM	C11		V	2		N	D	B & C CHGNG PUMPS RUNNING - PSZR LVL STILL FALLING	PUMP AIR BOUND - TYPE TX-150
W	RO2	019345	062277	G	PM	C11		V	1		N	D	"C" CHGNG PMP WOULD NOT CONTROL PSZR LEVEL	PUMP WAS AIR BOUND - TYPE TX-150
W	RO2	019793A	112377	H	PM	U01		N	3		N	D	BREAKERS FOR ALL 3 SAFETY INJ PMPS FOUND RAKD OUT	FAILURE TO RECOG TS LIMIT FOR GT 200 F OP
W	RO2	026063	041479	H	PM	B00			1		T	U	'A' SI PUMP FAILED TO START	CAUSE UNKNOWN
W	RO2	032732	081180	H	PM	B13		S	1		T	T	'A' SI PUMP BKR FAILED TO CLOSE	HIGH RESISTANCE ALARM SWITCH CONTACT
W	SA1	017700A	050677	H	PM	U01		U	2		R	D	BOTH SI PUMPS AND 1 CENTRIFUGAL CHG PMP TAGGED OUT	PERSONNEL ERROR - NOT FOLLOWING PROCEDURE
W	SA1	017700B	050677	G	PM	U01		U	1		R	D	BOTH SI PUMPS AND 1 CENTRIFUGAL CHG PMP TAGGED OUT	PERSONNEL ERROR - NOT FOLLOWING PROCEDURE
W	SA1	023232A	112778	G	PM	B13		T	1		N	T	NO 11 CHR PUMP FAILED TO START DURING SI	BUS FAILURE DUE TO OUTPUT TRANSF FAILED
W	SA1	024006	112879	H	PM	B14		R	1		N	D	SI PUMP FAILED,LOOSE LOCKNUTS FOUND,SHAFT BENT	REVERSE ROTATION POSSIBLE CAUSE,#12 PUMP
W	SO1	030728	031880	G	PM	D21			1		N	T	HIGH TEMP IND ON SOUTH CHR PUMP'S THRUST BEARING	LOOSE COUPLING CAUSED BEARING TO BE WIPED
W	SU1	002022	111072	G	PM	A19			1		U	U	EXCESSVE SEAL LEAKAGE ON "A" CHARGING PUMP	SEAL DAMAGED
W	SU2	000519	111373	H	PM	B02		U	1		U	D	SAFETY INJ/CHG PUMP 2-CH-P-1B DID NOT START-MANUAL	FUSES WERE NOT INSTALLED IN CONT CIRCUITS
W	TR1	0140678	012576	G	PM	B13		T	1		T	D	B TRAIN CHARGING PUMP(ST) DID NOT START	SEQ CONT RATED AT TOO HI AMPACITY
W	TR1	017572	030277	H	PM	B13		T	1		N	D	ONE OF TWO SAFETY INJ PUMPS FAILED TO START	IMPROPER ACTUATION OF DBA SEQ CONTACTS
W	TR1	018168A	052877	H	PM	B13		T	1		T	D	B SAFETY INJ PUMP DID NOT START - AUTOMATIC	SEQUENCER CONTACTS OPER WITH TOO LOW CONT
W	TR1	018452	070177	G	PM	D14			1		N	U	SOUTH CENTRFGL CHRG PMP ROTOR FAILD	DETAILD ANALYSIS UNDERWAY
W	TU3	000780	020574	H	PM	B13		S	1		N	D	3A SAFETY INJ PUMP FAILED TO START	INSUFFICIENT CHARGE ON BRKR CLSG SPRING
W	TU3	010136	050374	H	PM	C11		U	1		N	D	SAFT INJ PMP STOPPD WHEN LOW RUN CURRNT/PRESS SEEN	AIR LEAKAGE INTO PUMP CASING
W	TU3	014880	021976	G	PM	A16		R	1		N	U	WATER LEAKING FROM 3A CHARGNG PMP DURNG NORMAL OPS	CRACK IN CASING BETWEEN VALVCHMBR/STUFF B
W	TU3	016258	101576	G	PM	B21			1		N	T	"3B" CHRG PMP OOS DUE TO DAMAGE TO CONNECTING ROD	INSUFCNT LUBRICTN TO CONN ROD BEARINGS
W	TU3	021010	031578	G	PM	C11		R	1		M	T	"3A" CHRG PMP HAD CRACKD PMP CASING	HI CYCLIC STRESSES

ALL FAULTS IN PWR HPCI AND CVC PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	TU3	025775	030279	H	PM	C17			1	M	U	3B SI PUMP FOUND TO BE RUBBING	CAUSE UNKNOWN, IMPELLERS MOVED
W	TU3	026562	070179	G	PM	A19			1	N	T	3B CHARGING PUMP REMOVED FROM SERVICE	FAILED PRIMARY AND SECONDARY PACKING
W	TU4	027106	081579	G	PM	A19			1	N	T	4A CHARGING PUMP REMOVED FROM SERVICE	SEAL FAILED
W	TU4	027239	091179	G	PM	A19		R	1	N	T	4C CHARGING PUMP REMOVED FROM SERVICE	FAILED SEAL
W	YR1	016649	121676	H	PM	A16			1	T	T	#1 HPSI PMP SHAFT HOUSNG SEAL LEAKED	CUT IN GASKET BETWN HOUSNG/STUFFNG BOX
W	ZI1	000317	091073	G	PM	B13	S		1	N	T	THE 1B CHARGING PUMP WAS INOPERABLE-DID NOT START	FEEDER BRKR BRUSHHOLDER MISSING-VIBRATION

APPENDIX D
ONE-LINE DATA SUMMARIES

APPENDIX D
ONE-LINE DATA SUMMARIES

This appendix gives a listing of one-line summaries of all the LERs considered in this report. They are ordered by vendor, plant, and date. Following this, a second listing is given, of one-line summaries of the common cause events.

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
B	AR1	013015	070775	G	PM	B01	C		1	N	D		P36C M/U PUMP STARTED AND IMMED TRIPPED, PUMP FRZN	RAN WITH NO SUCTION, INCORRECT VLV LINE-UP
B	AR1	015609	081676	K	PM	A19	R		1	N	D		"D" RCP SEAL FAILED CREATING 25 GPM RCS LEAK	CAUSE OF SEAL FAILURE UNKN, OTHR FAILRS OC
B	AR1	016195	100376	G	PM	D08			1	N	T		P36B STOPPED DUE TO OVR-CURRENT AND LOSS OF PRESS	EXCESSIVE INTERNAL COMPONENT WEAR
B	AR1	020529	120377	K	PM	A19	R		1	N	T		"C" RCP OUTER SEAL FAILED CREATING 5-6 GPM LEAK	ASSUMED NATURAL END-OF-LIFE SEAL FAILURE
B	AR1	026244	061679	B	PM	D02			1	N	D		EMERGENCY FEED WATER PUMP P7B DEVELOPED A HOT BEAR	FAULTY INSTALLATION DURING PREV MAINTEN.
B	AR1	026491	062179	B	PT	B01	U		1	N	D		EFW PUMP P7A KEPT TRIPPING ON OVERSPEED	WATER IN STEAM LINES DUE TO TRAPS ISOLATE
B	AR1	027885	120679	B	PT	C13			1	T	T		EFW PUMP P7A DID NOT DEVELOPE PROPER DELTA PRESS.	LOOSE LOCK NUT ON SPEED GOVENOR
B	AR1	031027	051080	K	PM	A19	R		1	N	U		RCP "C" SEAL FAILED	REPLACED SEAL
B	AR1	031606	062480	B	PT	D00			1	N	U		STEAM DRIVEN EFP STARTED THEN TRIPPED ON OVERSPEED	SPURIOUS-CAUSE UNKNOWN
B	AR1	031817	070680	B	PT	D02			1	T	D		EMERGENCY FEEDWATER PUMP TRIPPED ON OVERSPEED	BROKEN STUD BOLTS ON GOV STEAM VALVE
B	CR3	017323	030177	B	PT	B04	R		1	N	D		EFWP TRIPPD ON OVERSPEED WHILE START ON MAIN STEAM	SLOW GOVNR RESPONSE ON REMOTE START
B	CR3	017657	041677	B	PT	B04	R		1	T	D		EFWP TRIPPD WHILE ATTEMPTN TO START ON MAIN STEAM	NEW GOVNR SLOW RESPONSE WITH MAIN STEAM
B	CR3	017938*	052977	I	PM	B00	V		2	N	U		CHEM ADD PMPS 3A & 3B FOUND INOP FOR PLANT S/U	CAUSE UNKN, PUMPS FLUSHED, RTND TO SERV
B	CR3	018288	060277	B	PT	B04	T		1	T	D		EFP-2 OVERSPEED TRIP ON INITIAL START	WATER IN STEAM SUPPLY PRVNTD THROTL CLOSN
B	CR3	018245	061677	B	PT	D21	R		1	N	U		STM DRIVEN EFWP (EFP-2) IN RECIRC MODE, WAS S/D	FAILURE OF THE OUTBOARD PUMP BEARING
B	CR3	018400*	070977	I	PM	C11	V		2	N	D		DISCOVD CHEM ADD PMPS 3A & 3B INOP, PLANT AT POWER	PUMP BELIEVED AIRBOUND, VENT VLV INSTALED
B	CR3	018564	071777	B	PT	B04	T		1	N	D		EFP-2 OVERSPEED TRIP ON AUTOSTART	MODIFIED DRAIN SYS. &BYPASS AROUND IN. VLV
B	CR3	019803	112277	B	PT	D21	R		1	N	D		STM DRIVEN EFWP (EFP-2) TRPD AFTR RNNG APPX 10 MIN	INBD, OTBD BRNG FLR, ERRNEOUS SITEGLS LEVEL
B	CR3	021167	042578	R	PM	C15			1	M	D		LOW FLOW EXISTED ON DECAY HEAT REMOVAL PUMP 1-A	PUMP SHAFT SHEARED, BEING EVALUATED
B	CR3	022309*	080278	I	PM	C11	V		2	T	D		CHEM ADD PUMPS FAILED TO DEVELOP DISCHARGE PRESS.	CAP1A AND 1B BECAME AIRBOUND
B	CR3	025927	042379	I	PM	C00	R		1	N	U		CHEMICAL ADD PUMP FAILED TO PUMP (CAP-1B)	CAUSE UNKNOWN
B	DB1	019374	091777	G	PM	A19			1	N	D		MAKEUP PUMP 1-2 HAD OIL LEAK ON OTBD BRNG END PLT	O-RING ON END PLATE DID NOT FORM ADEQ SL
B	DB1	019426	101677	B	PT	D04	B		1	T	D		GOVNR CLOSED ON AFP 1-2	VIBRATION CAUSING GOVNR TO CLOSE-DESIGN
B	DB1	019531	110877	B	PT	B04	B		1	N	D		GOVNR VALVE CLOSED DUE TO SURGING VIBRATIONS	NO FORCE TO HOLD GOVNR OPEN--MOD. REQUSTD
B	DB1	019712*	112977	K	PM	D13	O		4	N	D		ALL 4 RCP'S TRIPPD DUE TO LOSS OF 13.8 KV POWER	REACTOR/TURBINE TRIP OCCURED AT 2243 HOUR

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
B	DB1	019940	121177	B	PT	B13		R	1		T	D	CONTROL OF AFP TURBINE LOST CONTROL AFPT 1-1	MECHANICAL BINDING OF GOVNR
B	DB1	020218	122877	B	PT	C04		T	1		T	D	AFPT 1-2 SPEED CONTROL LOST;WILL MODIFY RELAYS	FAILD RELAYS IN CONTROL CKT.;MODIFIED DSN
B	DB1	020271	010678	B	PT	C04		T	1		N	D	AFPT 1-1 LOSS OF SPEED CONTROL; RELAY FAILURES	SPEED CONT. CKT. MODIFIED--UPGRADED RELAY
B	DB1	020274*	011278	F	PM	U01		N	2		N	D	BOTH CONT SPRAY PMPS INOPERABLE R/X IN MODE 4	PUMP CKT.BKRS. RE-ENERGIZED
B	DB1	020277	011678	R	PM	B13		T	1		T	T	DECAY HEAT PMP 1-1;FUSES IN BKR. START CKT.	POOR FUSE CONTACT IN CKT
B	DB1	021570	052878	R	PM	D01		T	1		N	D	POWER LOST TO DECAY HEAT PUMP 1-2,OH FLOW LOST	PERSONNEL TRIPPED PS BUSSES TO PUMP ACCI.
B	DB1	021859*	061578	R	PM	D02		T	2		N	D	POWER SUPPLY LOST 3 TIMES TO DECAY HEAT PUMP	2 PERSONNEL ERRORS
B	DB1	021858	061678	G	PM	D12			1		T	T	HORIZONTAL VIBRATION ON HPCI PUMP 1-1	PUMP WAS MISALIGNED DUE TO LOOSE MOUNTS
B	DB1	021855	061878	F	PM	B13		S	1		T	T	CONTAINMENT SPRAY PUMP FAILED TO START AUTOMATIC.	SFAS OUTPUT MODULE CAUSED FAILURE
B	DB1	021959	071078	J	PM	D21			1		T	T	COMP COOLING WATER PUMP 1-1 HAD EXCESS. VIBRATION	FAILED AND IMP. CLEARANCES ON BEARINGS
B	DB1	022690	091578	J	PM	D01		U	1		N	D	COMP. COOLING WATER PUMP 2 TRIPPED	PERSONNEL DID NOT REOPEN HX OUTLET VALVE
B	DB1	025525A	010379	G	PM	C04		U	1		T	D	HPI PUMP 1-1 FAILED TO DEVELOP SUFFICIANT RECIRC	HEAT TRACE UNABLE TO MAIN LINE ABOVE FREZ
B	DB1	025525B	010379	G	PM	U04		U	1		T	D	HPI PUMP 1-2 MAY NOT HAVE HAD SUFF. RECIRC	HEAT TRACE UNABLE TO MAIN LINE ABOVE FREZ
B	DB1	025139	011579	K	PM	B01		U	1		N	D	RCP 1-2-2 STARTED WITH INCORRECT BKR ALIGNMENT	PERSONNEL ERROR
B	DB1	025526	022879	K	PM	D02		S	1		N	D	RCP 1-1-2 TRIPPED,DUE TO LOW COMP COOL H2O FLOW	PERSONNEL MAINTENANCE LOOSENED WRONG CCVE
B	DB1	025603	032979	G	PM	L09			1		N	D	MAKE UP PUMP 1-1 DEVELOPED VIB AND DECRE PERFORM.	FOREIGN DEBRIS FAILED WEARING RING
B	DB1	027335*	101579	K	PM	D13	0		4		N	U	LOSS OF OFFSITE POWER CAUSED LOSS OF ALL 4 RCPS	LOSS OF OFFSITE POWER-OUTPUT BRKR FAULT
B	DB1	027420	102279	B	PT	D18			1		T	T	AUX FEED PUMP TURBINE BEARING HAD NO LUB OIL	LOOSE SIGHT GLASS
B	DB1	027421	102379	K	PM	D11			1		N	D	RCP 1-1-1 SECURED DUE TO BAD SEALS	THERMAL SHOCK
B	DB1	027422	102579	K	PM	D13		S	1		N	D	RCP 2-2 TRIPPED	BLOWN FUSE IN INTERLOCK CONTROL CIRCUIT
B	DB1	027857	110879	R	PM	B13		T	1		N	T	DHR PUMP 1 FAILED TO START	FAULTY SWITCH
B	DB1	027859	111279	G	PM	B05		S	1		T	D	HPI PUMP 1-1 FAILED TO START	FACTORY DEFECT IN CONTROL CIRCUIT WIRING
B	DB1	027867	112679	K	PM	D00			1		N	U	RCP 1-2 TRIPPED DUE TO LOW OIL LEVEL ALARM	NO CAUSE GIVEN
B	DB1	027918	120879	J	PM	B13		S	1		N	T	COMPONENT COOLING WATER PUMP #1 FAILED TO START	FAILED BREAKER AC113 ON BUS C1
B	DB1	030051	010380	B	PT	C13		R	1		T	T	AUX FEED PUMP DECLARED INOPERABLE (NO. 1-1)	BURR ON HIGH SPEED STOP PIN,MISADJ CLUTCH

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
B	DB1	030928	040680	F	PM	U02			1		N	D	OIL SIGHT GLASS FOR CONT SPRAY PUMP 1-2 BROKE	BROKEN BY CONTRUCTION PERSONNEL
B	DB1	031610	062380	G	PM	U01	C		1		N	D	HPI PUMP 1-1 BEARING THERMOCOUPLE WELLS BROKEN	ASSUMED TO BE STEPPED ON
B	DB1	032122	081380	R	PM	D02	S		1		N	D	DH PUMP 1-2 WAS STOPPED WHEN SUCTION VLV CLOSED	MAINTENANCE FAILED TO DEFEAT INTERLOCK
B	DE1	014806A	012876	L	PM	B02	U		1		T	D	LOW PRESS INJECTION PUMP 1A - INOPERABLE	INCORRECT SUBSTITUTE BREAKER INSTALLED
B	DE1	0148068	012876	F	PM	B02	U		1		T	D	REACTOR BUILDING SPRAY PUMP - INOPERABLE (1A)	INCORRECT SUBSTITUTE BREAKER INSTALLED
B	DE1	014806C	012876	G	PM	B02	U		1		T	D	HIGH PRESSURE INJECTION PUMP - INOPERABLE (1A)	INCORRECT SUBSTITUTE BREAKER INSTALLED
B	DE1	025915	041979	F	PM	A05			1		T	D	1B RB SPRAY PUMP FOUND LEAKING AROUND VENT LINE	PLUG WAS SUPPOSED TO BE IN LOCATION OF VE
B	DE1	031186	050980	B	PT	D09			1		T	T	EFW PUMP DECLARED INOP DUE TO NOISE FROM BEARING	BEARING FAILED DUE TO WATER IN OIL
B	DE1	031669	061880	I	PM	C14			1		N	T	BORIC ACID TRANSFER PUMP DECLARED INOP	FAILED MOTOR,DIAPHRAM & VACUUM COMP VLV
B	DE2	000577	111273	L	PM	B01	U		1		T	D	LOW PRESSURE INJECTION PUMP 2B FAILED TO START	BREAKER NOT RACKED IN PROPERLY
B	DE2	000688	012274	K	PM	D19			1		N	U	REAC COOLNT PMP RCP2B2 FAILD CAUSE NOT YET DETRMND	DISASMBLY SHOWD 1 CAPSCREW ,SPIROL MISSNG
B	DE2	011071A	120974	L	PM	U08	S		1		T	D	COMMON SUCTION VALVE FOR 1 LPCI AND 1 CONT SPRAY P	UMP FAILED TO OPEN - OPEN CKT IN 1 PHASE
B	DE2	0110718	120974	F	PM	U08	S		1		T	D	COMMON SUCTION VALVE FOR 1 LPCI AND 1 CONT SPRAY P	UMP FAILED TO OPEN - OPEN CKT IN 1 PHASE
B	DE2	031916	071380	G	PM	D21			1		N	T	2B HPI PUMP REMOVED FROM SERVICE	BAD BEARING CAUSE NOT STATED
B	DE2	033125	072690	G	PM	D18	R		1		N	U	2B HPI PUMP DECLARED INOPERABLE,DEVELOPED HOT BEAR	UPWARD PRESSURE OF MOTOR AGAINST UP BEAR.
B	DE2	032153	073080	I	PM	C00	R		1		N	U	BORIC ACID TRANSFER PUMP DECLARED INOPERABLE	CAUSE NOT STATED
B	DE2	032311	080580	I	PM	C09	T		1		N	T	BORIC ACID XFER PUMP UNABLE TO PUMP DOWN LOST	STRAINER WAS BLOCK
B	DE2	032430	082280	I	PM	D14			1		N	T	CON BORIC ACID STORAGE TANK PUMP DECLARED INOPER.	WORN WORM GEAR,BAD GASKET,& TORN OIL SEAL
B	DE2	032776A	092880	I	PM	C00			1		N	U	CBAST PUMP FAILED TO PUMP FROM CBAST TO LOST	LOW OIL LEVEL IN PUMP,CAUSE NOT GIVEN
B	DE2	0327768	093080	I	PM	B01	S		1		N	D	CBAST PUMP DECLARED INOPERABLE	COUNTER NOT RESET
B	DE3	012877	043075	B	PT	B02			1		T	D	EMERGENCY FEED PMP INOPRBL DUE TO TIGHT PACKNG GLN	PERSONL DID NOT VERIFY OPRBLTY AFTR MNTNC
B	DE3	019484	090177	F	PM	D04			1		T	D	EXCESV NOIS DURNG VIBRTN TST OF 3B R/X BLDNG SPRAY	OIL LEVEL IND IMPROPERLY POSITIONED
B	DE3	023435	122078	F	PM	D14			1		T	T	REACTOR BUILDING SPRAY PUMP DECLARED INOPERABLE	HIGH VIBRATION DUE TO LOOSE IMPELLER
B	DE3	028046	040479	F	PM	D02			1		T	D	OIL DISCOVERED LEAKING FROM PUMP CASING,PUMP SEC.	BEARING CAP INSTALLED INCORRECTLY
B	RS1	011151	103074	B	PM	B01	C		1		N	D	AUX PMP SEAL RINGS FROZN TO BUSHNGS AND BSHN TO SH	OPERATR FAILD TO OPEN SUCTN VALV TO FEED

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
B	RS1	013184	051975	B	PM	D13		S	1		T	T	MOTOR FOR AUX FEED PUMP P-318 TRIPPED OFF LINE	LOOSE LOCKNUT ON OVERCURRENT DELAY RELAY
B	RS1	014502	032376	G	PM	D00			1		N	U	HPCI P238A TRIPPD OFF LINE WHEN AT 100% POWER	NO CAUSE COULD BE FOUND THRU TESTING
B	RS1	016012	082276	R	PM	A19		R	1		T	T	EXCESS LEAKAGE ON B PMP OF DECAY HEAT DURNG SRVLNC	LEAK CAUSD BY STUFFING BOX GASKET
B	RS1	016711	112376	F	PM	B01	U		1		T	D	RX BLDG SPRAY PUMP FAILED TO START	BRKR WAS NOT RACKED IN CORRECTLY
B	RS1	017233	021877	B	PT	U03		S	1		N	D	STEAM DRIVE TO AUX FEED P318 TRIPPD P319 OOS	OPERATR FAILD TO RESET TRIP WHEN P318 TST
B	RS1	021744	062278	R	PM	A19		R	1		N	T	B DHR PUMP SEAL FOUND LEAKING	LEAKING SEAL REPLACED
B	RS1	026886	071979	L	PM	A19		R	1		T	T	DHR PUMP 'B' LEAKED IN EXCESS OF TECH SPEC	FAILED SEAL,SEAL REPLACED
B	RS1	030263	011780	R	PM	A19			1		N	T	LEAKAGE OBSERVED FROM 'A' DHR PUMP SEAL	SEAL WAS REPLACED
B	RS1	031779	071280	B	PT	B00			1		T	U	AUX FEED PUMP P-318 FAILED TO START	CAUSE UNKNOWN
B	TI1	011016	101074	G	PM	B02		S	1		T	D	MAKEUP PUMP 1A TRIPPED ON MANUAL ACTUATION	WRONG LUG USED TO CONN FOR CBL TO MTR WDG
B	TI1	011015	101774	G	PM	B13		S	1		T	D	MAKEUP PUMP 1C FAILED TO START - AUTOMATIC	WESTINGHSE ACB HAD DISLGD TRIP LTCH SPRNG
B	TI1	012103	010375	G	PM	B13		S	1		T	D	HIGH PRESS INJ PUMP MU-P1C FAILED TO START	LOOSE TERMINATION ON BRKR RELEASE
B	TI1	014220	021776	G	PM	B06		C	1		T	D	"A" MAKEUP/PURIF PMP STARTED WITH IMPROPR VALV L/U	PMP FAILURE DUE TO INAD PROCEDRES/PERSONNL
B	TI1	020997*	031878	G	PM	D13		U	2		T	D	THE 1A & 1C MAKEUP PMPS TRIPPED ON XFER TO SITE PR	MALFUNC TIME DELAY RELAY IN LOW L.O. CKT
B	TI1	025503	021779	G	PM	D18			1		T	T	HPI PUMP MU-P-1C TRIPPED ON OVERLOAD	FAILED LEAD INSIDE PUMP MOTOR
C	AR2	026488	071979	B	PT	B04	T		1		N	D	EFW PUMP 2P7A TRIPPED ON OVERSPEED	MOISTURE IN STEAM LINE,NO TRAPS INSTALLED
C	AR2	026913	081879	B	PT	B13	R		1		N	T	EFW PUMP 2P7A TRIPPED ON OVERSPEED	STICKING LINKAGE ON GOVENOR
C	AR2	027125	092379	B	PT	B04	T		1		N	T	EFW PUMP 2P7A TRIPPED ON OVERSPEED,MOISTURE IN SL	TRAPS NOT REMOVING MOISTURE IN STEAM LINE
C	AR2	028076	123079	B	PT	B04	T		1		N	T	EFW PUMP 2P7A TRIPPED ON OVERSPEED	STEAM TRAP ISOLATED,MOISTURE IN STEAM LIN
C	AR2	031023A	040780	B	PM	C11		U	1		N	D	BOTH TRAINS OF EFW PUMPS CAVITATED AFTER LOSS OF P	FORCED FLOW STOPPED IN FW SYS OH WATER
C	AR2	031023B	040780	B	PT	C11		U	1		N	D	BOTH TRAINS OF EFW PUMPS CAVITATED AFTER LOSS OF P	FORCED FLOW STOPPED IN FW SYS OH WATER
C	AR2	031376	050680	B	PT	D13		R	1		T	T	EMERGENCY FEED PUMP KEPT TRIPPING ON OVERSPEED	MISADJUSTMENTS ON GOVENOR
C	AR2	031381	052080	B	PT	D00		R	1		N	U	EMERGENCY FEEDWATER PUMP TRIPPED ON OVERSPEED,2P7A	UNKNOWN CAUSE
C	AR2	031671	061080	B	PT	C02		S	1		N	D	EMER FW PUMP 2P7A WOULD NOT EXCEED 1000 RPM	INCORRECT WIRING ON RAMP GEN AN EGM GOV.
C	AR2	031674	062780	B	PT	D00		R	1		N	U	EMERGENCY FEEDWATER PUMP TRIPPED ON OVERSPEED	UNKNOWN CAUSE,PUMP NO.2P7A

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
C	AR2	032094A	071780	B	PT	D04		R	1		T	D	EMERGENCY FEEDWATER PUMP 2P7A TRIPPED ON OVERSPEED	BELIEVED TO BE DESIGN RELATED
C	AR2	032094B	080480	B	PT	D04		R	1		U	T	EMERGENCY FEED PUMP 2P7A TRIPPED ON OVERSPEED	BELIEVED TO BE DESIGN RELATED
C	AR2	032094C	082980	B	PT	D04		R	1		U	T	EMERGENCY FEED PUMP 2P7A TRIPPED ON OVERSPEED	BELIEVED TO BE DESIGN RELATED
C	CC1	011272	112574	F	PM	C07			1		T	T	DURING TEST, CONTAIN SPRAY PMP #11 TOH OOS LOW	NORMAL WEAR OF PUMP INTERNALS
C	CC1	012449	021675	J	PM	B13		S	1		T	D	NO 11 CCW FAILD TO START UPON SIS SIGNAL	RELAY IN ESFAS BURNED CONTACTS
C	CC1	013189	080175	G	PM	A19		R	1		U	U	#13 CHARGING PUMP RELEASED GAS ACT TO AUX BLDG	PLUNGER PKG LKG (UTEX INDUS. PART# SF194)
C	CC1	013277	081075	K	PM	A19			1		N	U	11B RX COOLANT PUMP DEVELOPED 2.7 GPM LEAK	BOTH UPPER AND MIDDLE MECH SEALS FAILED
C	CC1	013389	091175	G	PM	A19		R	1		U	U	#13 CHG PUMP RELEASED GAS ACT FROM UA-1 MAIN VENT	PLUNGER PACKING LEAKED EXCESSIVELY
C	CC1	014754	050476	G	PM	D00		S	1		N	U	#13 CHARGN PUMP TRIPPD DUE TO BREAKER OPENING	CAUSE FOR OPENING OF BKR. UNKNOWN
C	CC1	014753	050576	B	PT	D05			1		N	D	#12 AUX FD PMP S/D FOR REPAIR OF THTL TRIP LATCH	TAPPET NUT INCORRECTLY SIZED PER PLANS
C	CC1	015223	062176	F	PM	U12		R	1		N	T	NO 12 CONTAINMENT SPRAY PUMP WAS TAKEN OUT OF SERV	REPAIR SMALL LEAK IN SEAL WTR PIPE NIPPLE
C	CC1	018287	062277	F	PM	U12		R	1		N	T	NO 12 CONTAINMENT SPRAY PUMP WAS TAKEN OUT OF SERV	LEAKING SEAL WTR COOLER CASING FITTINGS
C	CC1	019485	072977	G	PM	A19		R	1		N	T	#12 CHARGING PUMP REMOVED FROM SERVICE	REPAIR SLOWLY INCREASING PACKING LEAK
C	CC1	019688	111377	G	PM	A19		R	1		N	T	#12 CHG PUMP S/D AND ISOLATED	EXCESSIVE PACKING LEAKAGE, PACKING FAILED
C	CC1	020358	012378	R	PM	C13		S	1		N	D	#12 LPSI COULDN'T BE TRIPPD FROM CONTROL RM	MISSING SCREW IN TRIP ACT. LEVER ON BREKR
C	CC1	023310	110378	B	PT	B13			1		T	D	11 AUX FEED PUMP DECLARED INOPERABLE	THROTTLE VALVE STUCK SHUT AFTER TEST TRIP
C	CC1	026235	050779	R	PM	D03		U	1		N	D	#11 LPSI PUMP WAS STOPPED WHILE IN RHR MODE	SPURIOUS RECIRC ACT SIG BY PERSONNEL TEST
C	CC1	026718A	080679	G	PM	D13		S	1		N	T	#12 CHARGING PUMP TRIPPED ON LOW SUCITON PRESSURE	FAULTY PRESSURE INDICATING SWITCH
C	CC1	026718B	080679	G	PM	A19			1		N	T	#11 CHARGING PUMP ISOLATED DUE TO LEAK	PACKING FAILED
C	CC2	017049	012177	G	PM	C14			1		N	T	FLOW FROM #21 CHG PMP DECREASED TO ABOUT 39 GPM	INVEST REVEALED TWO DISCH VLVS BROKEN
C	CC2	017456	031477	B	PT	U16		S	1		U	U	#21 AUX FEED PUMP REMOVED FROM SERVICE	REPAIR LEAK ON SERVICE WATER SUPPLY LINE
C	CC2	017692	111477	B	PT	B09			1		N	T	21 AFW LOW PRESS BRNG TEMP ALARM--WTR IN CASING	RUST FROM TURBINE CASING CAUSD FAILURE
C	CC2	017691	111677	B	PT	D13			1		N	U	#21 AFW PLACED OOS BINDING GOVERNOR CONTROL KNOB	BENT PIN ON MAN. SPEED SETTING KNOB
C	CC2	021059	070478	K	PM	A16		R	1		N	T	CRACKED WELD DISCOVERED ON 21B REACTOR COOLANT PUM	CAUSE OF WELD CRACK IS UNKNOWN
C	CC2	021844	071478	K	PM	D02		R	1		N	D	RCP SEAL COOLING HEAT EXCHANGER WELD FAILED	PREVIOUS WELD REPAIR WAS INADEQUATE

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
C	CC2	022604*	092478	R	PM	D13		U	2	N	T		BOTH LPSI PUMPS TRIPPED BY RAS SIGNAL	LEVEL INDICATOR FOUND TO BE OUT OF CAL.
C	CC2	022646*	101778	R	PM	C06		U	2	N	D		BOTH 21 AND 22 LPSI PUMPS LOST SUCTION	AIR LEAKED FROM PURIFICATION SYS TO SDC
C	CC2	023173*	121278	G	PM	A19			2	N	T		21 AND 22 CHARGING PUMPS HAD EX PRI PACKING LEAKS	PACKINGS REACHED EOL SIMULTANEOUSLY
C	CC2	025180	012779	B	PT	B13		R	1	T	T		THROTTLE VLV FOR #22 AUX FEED PUMP WOULD NOT RESET	ACME THREAD OF TRAVELING NUT DISENGAGED
C	CC2	027373	102779	H	PM	D19			1	N	T		HPSI PUMP "A" FAILED,REQUIRING SECURING THE PUMP	MECHANICAL SEALS FAILED ON #22 HPCI PUMP
C	CC2	030678A	022580	L	PM	D00			1	U	U		LPSI PUMP 21 TAKEN OUT OF SERVICE FOR CORR. MAINT.	CAUSE NOT GIVEN
C	CC2	030678B	022580	F	PM	D02			1	U	U		CONT SPR PUMP 21 TAKEN OOS BY MISTAKE	MISUNDERSTANDING, SHD HAVE BEEN LPSI 21
C	FC1	000479	101073	B	PT	B13		S	1	T	D		AFPT FW-10 FAILD TO START DURING TEST	BACKPRESSURE TRIP DEVICE MALFUNCTIONED
C	FC1	000613	112073	J	PM	U04		R	2	U	T		COMPONENT COOLING WATER IMPELLER CRACKING	CAST IRON IMPELLERS CHANGED TO BRONZE
C	FC1	012513	040375	G	PM	B09		S	1	T	T		CHARGING PUMP CH-1C FAILD TO START	DIRTY TIMING RELAY CONTACTS
C	FC1	013525	092075	K	PM	A00			1	N	U		REACTOR COOLANT PUMP VAPOR SEALS LEAKED	CAUSE NOT GIVEN
C	FC1	025844	042079	F	PM	B01		U	1	T	D		CONTAINMENT SPRAY PUMP FAILED TO START (SI-98)	SUPPLY BREAKER BOUND DUE TO PERSONNEL ER.
C	FC1	031635*	051680	K	PM	A16			3	T	T		RCP'S 3A,B,&C FOUND LEAKING BETWEEN CASING & COVER	CORROSION TO STUDS & DETERIORATED GASKETS
C	FC1	032766	092680	G	PM	D19		S	1	N	T		"A" CHARGING PUMP BECAME INOPERABLE	PACKING COOLING WATER PUMP FAILED
C	MI2	014602	050276	G	PM	C19			1	T	T		"A"CHARGING PUMP NO FLOW ON AUTOMATIC START	GROSS PACKING LEAKS
C	MI2	017374	121276	G	PM	D00			1	N	U		"C" CHARGING PMP TAGGD OUT DUE TO EXCESSIVE NOISE	UNKNOWN
C	MI2	018735	070377	B	PM	U09		R	1	N	T		H2O IN "B" AUX FEED THRUST BRNG OIL DAMAGD BRNG	H2O ENTERED BRNG ALONG PUMP SHAFT
C	MI2	018738	071277	B	PT	C13			1	T	T		STM DRIVEN AUX FD PMP FAILED TO TRIP ON OVERSPEED	HARDENED GREASE IN TRIP/THTL VLV
C	MI2	021915	061978	B	PT	C02		S	1	T	D		AUX FEED PUMP WOULD NOT GO ABOVE MIN 1400 RPM	HAND SW. ON CONTROL BOARD MISALIGNED
C	MI2	025576	031479	R	PM	A11		U	1	N	D		LPSI PUMP LOST SUCTION DURING S/D COOLING	PUMP BECAME AIRBOUND
C	MI2	026283	061479	B	PM	B09		R	1	N	T		AUX FEED PUMP BECAME INOP DUE TO FAILED BEARING	CONTAIMINATION OF OIL BY WATER
C	MI2	030387	011880	F	PT	D03			1	T	D		AUX FEED PUMP BECAME INOP DUE TO BEARING FAILURES	PREVIOUS TEST WITH PUMP UNCOUPLED
C	MI2	030796	031080	G	PM	A19			1		T		CHARGING PUMP PLACED OUT OF SERVICE	PACKING FAILED,NATURAL END OF LIFE
C	MI2	030799	032180	B	PM	A19			1	N	T		AUX FEED PUMP LEAK EXCESSIVELY FROM GLAND PACKING	PACKING FAILED,NATURAL END OF LIFE
C	MI2	031945	070380	H	PM	D04		C	1	T	D		"A" HPCI PUMP SEIZED	PROCEDURE DID NOT REQUIRE MIN FLOW VLV OP

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
C	MI2	031946	071280	B	PT	D07			1	[illegible]	[illegible]	AUX FEED PUMP TRIPPED PRIOR TO OVERSPEED SETPOINT	WEAR TO EMERGENCY TAPPET NUT
C	MY1	002322	120272	H	PM	B02	U		1	T	D	HPSI P-145 SUPPLIED BY "A" DG DID NOT START	GROUNDING BLOCK NOT REMOVED FROM CKT BKR
C	MY1	021039	030278	G	PM	D02			1	T	T	1A CHARGING PMP STARTD FOR VIBRATN TEST--HI TEMP.	LOCKN PIN NOT INSTLLD TO BEARING
C	MY1	027208	091879	F	PM	C03	U		1	T	D	"B" TRAIN CONTAINMENT SPRAY PUMP DIS PRESS DROPPED	SUCTION VALVE WAS CLOSED
C	MY1	027289	100379	F	PM	B13	S		1	T	T	"A" TRAIN CONTAINMENT SPRAY PUMP FAILED TO START	CONTACT BLOCK IN PUMP BKR FAIL TO MADE UP
C	MY1	030992	040880	B	PM	D00			1	T	U	AUX FEED PUMP P-25A REQUIRED TO BE SHUTDOWN	OIL FROM BEARING,COULD NOT BE DUPLICATED
C	PA1	002049	040272	B	PM	C21			1	N	T	FLOW FROM MTR DRVN AUX FD PUMP P-8A 50 PRCT OF NOR	HYDROSTATIC BEARING FAILED - NO RECIRC
C	PA1	000202	072773	J	PM	D15			1	U	D	COMPNT COOLNG PMP P52C COUPLING FAILED	TEETH ON HUB STRIPPED
C	PA1	010659	071174	H	PM	C04			1	T	D	HPSI P66A TESTED UNSAT SHUTOFF HEAD NOT DEVELOPD	6TH STAGE IMPELLOR MOVED ON SHAFT
C	PA1	013008	070975	L	PM	C01	U		1	T	D	LPSI PUMP 67B NO FLOW, NO PRESSURE	TWO VALVES NOT IN CORRECT POSITION
C	PA1	013820	112275	L	PM	A04			1	N	D	LPSI PMP SEAL LEAKG PMP TYPE 8X21 A1,SER A-57393	IMPRPR ORING CLEARANCE
C	PA1	014719	042176	G	PM	B09			1	T	T	CHARGING PUMP P55-A WOULD NOT START PROPERLY	PLUGGED OIL FILTER
C	PA1	015311	072076	J	PM	D20			1	N	U	CCW PMP P52-C INBORD BRNG FAILD SHAFT METALLIZED	EITHER HOT END ALIGMNT OR BRNG SLIPPAGE
C	PA1	021117	041778	G	PM	B13	S		1	N	D	CHARGING PUMP P-55B WOULD NOT START	FAULTY CONTROL COIL IN CIRCUIT BREAKER
C	PA1	022913	103178	G	PM	A19			1	N	T	CHR PUMP P-55C TAKEN OUT OF SERVICE	LEAKING SEALS
C	PA1	025614	020179	K	PM	D00	S		1	N	U	PRIMARY COOLANT PUMP INADVERTANTLY STOPPED	CAUSE NOT GIVEN
C	SL1	016880	120876	B	PT	B13	S		1	U	D	STEAM DRIVEN AUX FEED PUMP WOULD NOT START	TRIP SOLENOID LATCH FAILED TO ENGAGE
C	SL1	017394A	022077	G	PM	D00	R		1	N	U	B CHG PMP SEAL LUBE WTR PMP FAILED DURING R/X S/U	MODEL SD11,TYPE 102,STYLE CZOOV
C	SL1	017394B	022077	G	PM	D0[illegible]	[illegible]		1	N	U	A CHG PMP SEAL LUBE WTR PMP FAILED DURING R/X S/U	MODEL SD11 TYPE 102 PART#78 15157
C	SL1	017393	022677	G	PM	[illegible]	[illegible]		1	N	U	DURING POWER OPS,A CHRGNG PMP SEAL LUBE WTR FAILED	FAILD TO DELIVER SUFFICIENT FLOW
C	SL1	017833*	041577	K	PM	[illegible]	[illegible]		4	N	D	LOSS OF SEAL CLNG WTR TO RCPS - RCPS WERE SECURED	CONTAINMENT INST AIR SYSTEM FAILED
C	SL1	017935*	051677	K	PM	[illegible]	N		4	N	D	LOST ALL FOUR REACTOR COOLANT PUMPS	LOSS OF OFF-SITE POWER
C	SL1	019503	081177	B	PT	B00	R		1	T	U	C STEAM-DRIVEN AUX FEED PMP FAILD TO START	STARTED ON 2ND TRY ,PREVIOUS FAILR RPORTD
C	SL1	023658	090278	G	PM	A16	R		1	M	T	CHR PUMP 1A FOUND TO HAVE SMALL CRACK IN BLOCK	CAUSE OF CRACK IS UNKNOWN
C	SL1	022649	100278	G	PM	B13	S		1	N	D	1B CHARGING PUMP FAILED TO START	ELEC INTER READ 0 SUCTION PRESSURE

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
C	SL1	025363	020879	B	PT	B13	R		1	T	U	AUX FEED PUMP 1C FAILED TO START	TRIPPED OVERSPEED TRIP,CAUSE UNKNOWN
C	SL1	025595	031679	G	PM	A16	R		1	N	T	1C CHARGING PUMP DEVELOPED CRACKED PUMP CASING	SUCTION CAVITATION & VIBRATION
C	SL1	026469	061479	B	PT	B18	R		1	T	T	AUX FEED PUMP 1C FAILED TO START	STEAM INLET VALVE FAILED TO OPEN
C	SL1	032587A	082880	G	PM	A00	R		1	M	U	SEAL WATER LEAK DEVELOPED IN 1B CHR PUMP	CAUSE NOT STATED
C	SL1	032587C	082880	G	PM	B00	S		1	N	T	1A CHR PUMP STARTED THEN APPARENTLY STOPPED	FAILED SEAL WATER PUMP
W	BV1	015214	070876	R	PM	A19			1	N	T	A RUPTURED SEAL WAS DISCOVERED ON 1A RHR PUMP	SEAL BOUND ON PUMP SHAFT CAUSING FAILURE
W	BV1	015727	082576	B	PM	C04			1	T	D	3A AUX FEED PUMP VAPOR BOUND CAUSING LOSS OF DISCH	DESIGN DEF OF RECIRC LINE SIZE & ORIFICE
W	BV1	0167518	121576	G	PM	A14	R		1	N	T	1C CHARGNG PMP LEAKING AT SPEEDINC. GEAR CASING	TUBE FAILURE OF L.O. COOLER
W	BV1	0167518	121576	G	PM	A14	R		1	N	T	1B CHARGNG PMP LEAKING AT GEAR CASING	TUBE FAILURE OF L.O. COOLER
W	BV1	017351	031077	B	PT	B00			1	N	U	STEAM AFP FAILD TO START WHEN R/X TRIPPD 50% POWER	CAUSE UNDETERMINED
W	BV1	017561	040377	R	PT	D15			1	T	T	LOUD NOISE DEVELOPED IN TURB DRIVEN AUX FEED PUMP	LOOSE COUPLING GUARD RUBBING ON COUPLING
W	BV1	018348	070577	G	PM	D15			1	N	U	1B CHARGING PUMP TRIPPED ON PHASE OVERCURRENT	PUMP SHAFT CRACKED AT BALANCE DRUM NUT
W	BV1	018241*	071977	K	PM	D04	N		3	T	D	LOAD REJECT. TEST FROM 50% PWR;PMPS TRIPPD UNDRFRQ	TURBINE CONTROL DESGN CONCEPTS
W	BV1	020130	121577	B	PT	C13			1	N	T	STEAM AFP GOVENR FAILD TO MAINTAIN SPEED CONSTANT	MALFUNCTIONING GOVERNOR VALVE
W	BV1	020132	121677	L	PM	D20			1	T	T	1A LHSI PUMP SHUTDOWN DUE TO HI VIBRATION ON SHAFT	PUMP-TO-MOTOR MISALIGNMENT
W	BV1	0213564	041678	G	PM	D09	S		1	N	T	1B CHARGN/SI PUMP HI BEARING TEMP ALARM	PLUGGED OIL PUMP COOLERS-WATER SIDE
W	BV1	0213568	041678	G	PM	D09	S		1	N	T	1C CHARGE/SI PMP HI BEARING TEMP ALARM PLGGD COOL	RIVER WATER STRAINERS TORN ALLOWING DEBRI
W	BV1	021646	042178	G	PM	D01	S		1	N	D	1C CHG PUMP TRIPPED. NO BACK-UP WAS AVAILABLE	OPERATOR MADE IMPROPER ELEC LINE-UP
W	BV1	022396*	070478	R	PM	C11	V		2	N	D	A AND B RHR PUMPS WERE RUNNING WITH NO DISCH FLOW	PUMPS BECAME AIR BOUND WITH RCS DRAINED
W	BV1	028145	010379	G	PM	C14			1	N	T	1C CHARGING PUMP HAD LOW DISCHAGE PRESSURE	FAULTY ROTATING ELEMENT
W	BV1	025486	030579	B	PT	B09			1	U	D	AUX FEED PUMP DECLARED INOPERABLE,TR VLV DID*NT CL	NUT AND WASHER DISCOVERED IN STEAM LINE
W	BV1	026481	070379	R	PM	D13	S		1	N	D	RHR PUMP WAS TRIPPED FROM CONT ISOLATION PHASE B	POWER SUPPLY SWITCHING CAUSE VOLT SPIKE
W	BV1	026841	081679	G	PM	D02	C		1	T	D	1C CHARGING PUMP BECAME INOPERABLE	FAILED BEARING DUE TO A COOLING VLV SHUT
W	BV1	026984*	091979	K	PM	D01	N		3	N	D	ALL THREE RCPS TRIPPED ON UNDERFREQUENCY	OPERATOR ERROR
W	BV1	028105	091079	L	PM	C09			1	T	D	LHSI PUMP FAILED TO REACH REQUIRED RECIRC FLOW	PIECES OF PLASTIC FIRE HOSE NOZZLE FOUND

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	BV1	030552	013180	I	PM	D13		S		1	N	T	BORIC ACID TRANSFER PUMP TRIPPED ON OVERLOAD	POSSIBLE FAULTY BLENDER CONTROLS,CH-P-2B
W	BV1	030879*	040880	R	PM	C06		V		2	N	D	RHR PUMPS BECAME AIRBOUND WHILE INCREASING FLOW	PROCEDURE REVISED TO VENT PUMPS
W	BV1	030880*	041180	R	PM	C11		V		2	N	D	'A' AND 'B' RHR PUMPS COULD NOT DEVELOP FLOW	PUMPS BECAME AIRBOUND
W	BV1	031790	062980	I	PM	D03		S		1	T	D	BORIC ACID TRANSFER PUMP TRIPPED	PERSONNEL TESTED BKR INCORRECTLY
W	BV1	032789	091780	G	PM	D02		U		1	T	D	1C HIGH HEAD CHARGING PUMP BEARING TEMP INCREASED	CHECK VALVES INSTAL BACKWARDS IN COOL H2O
W	BV1	032853	093080	I	PM	A19				1	N	T	2A BORIC ACID PUMP DEVELOPED LEAK (CH-P-2A)	WORN MECHANICAL SEAL,CRACK FOUND ON SHAFT
W	DC1	013078	070375	I	PM	C09				1	T	T	BOR ACID XFER PMP #2 FLOW 17.3 GPM, SPEC IS 20 GPM	BORIC ACID CRYSTALS IN VLVS & PIPES
W	DC1	013076	072075	I	PM	C19		R		1	N	D	#1 BOR ACID XFER PMP COULD NOT MEET DESIGN FLOW	MECHANICAL SEAL FAILED
W	DC1	013443	082475	I	PM	A19		R		1	N	D	#2 BOR ACID XFER PMP TAKEN OUT OF SERV, EXSV LKG	JOHN CRANE MECHANICAL SEAL FAILED
W	DC1	013410	092775	I	PM	A19		R		1	N	D	#2 BOR ACID XFER PMP TAKEN OUT OF SERV, EXSV LKG	JOHN CRANE MECHANICAL SEAL FAILED
W	DC1	013540	101775	I	PM	A19		R		1	N	D	#1 BOR ACID XFER PMP TAKEN OUT OF SERV, EXSV LKG	JOHN CRANE MECHANICAL SEAL FAILED
W	DC1	013541	102075	I	PM	A16				1	N	D	#1 BOR ACID XFER PMP TAKEN OUT OF SERV, CSNG SEPG	DAMAGE TO GASKET SEALING SURF ON CASING
W	DC1	015862	090676	B	PT	B04		S		1	N	D	LIMIT SWITCHES ON LINKAGE ROTATED ON SHAFT	SET SCREWS DID NOT HOLD ARMS IN PLACE
W	DC1	016115	101376	B	PT	B13		S		1	N	D	FAILD TO START FROM CONT. ROOM;TRIP LINKAGE STICKY	PAWL THAT ENGAGES THROTTLE STOP VLVE STCK
W	DC1	017650	040777	G	PM	D15		R		1	N	D	1W CENT CHG PUMP AMMTR PEGGED, PUMP DEENERGIZED	BROKEN SHAFT,CLEAN BRK UNDR 11TH STG IMP
W	DC1	017670	041877	G	PM	D02		S		1	N	D	"W" CHARGN PMP HIGHER THAN NORMAL CASING TEMPERATR	RAG STUCK IN RECIRC LINE DURIN ROTOR REPL
W	DC1	017769	051777	G	PM	D15		R		1	N	D	EAST CENT CHG PMP BRK BET 3RD & 4TH STG IMPELLERS	BREAK APPEARED TO BE A FATIGUE FAILURE
W	DC1	020067	122777	J	PM	B13		S		1	T	D	WEST COMP COOL WTR PMP FAILD TO START (MANUAL)	WIRE BROKEN AT TERMINAL BLOCK;HOT S/D PAN
W	DC1	020310	011678	I	PM	C19				1	T	T	#2 BOR ACID XFER PMP DISCH PRESS LOWER THAN REQD	LEAKING MECH SHFT SL. ATTRIB TO NOR WEAR
W	DC1	021939	071478	B	PT	B13		S		1	N	T	AUX FEED PUMP FAILED TO START ON START SIGNAL	SOLENOID THAT OP. TRIP THROTTLE,BURN OUT
W	DC1	022693	100278	B	PT	C13		R		1	R	U	AUX FEED PUMP FAILED TO REACH RATED SPEED	GOVERNOR WAS REPLACED
W	DC1	031811	070380	G	PM	D15		R		1	N	D	TRAIN B CENTRIFUGAL CHR PUMP FAILED WHILE OPER.	SHAFT BROKE
W	DC2	022892	110678	B	PT	B13		S		1	T	T	AUX FEED PUMP FAILED TO START ON SURVEILLANCE TEST	FAILED ZENOR DIODE IN OVERSPEED MONITOR
W	DC2	025459	030679	B	PT	D21				1	T	T	AUX FEED PUMP TAKEN OOS DUE TO A HOT BEARING	BEARING FAILED,UNKNOWN CAUSE
W	DC2	030279A	012480	B	PT	C07				1	T	T	AUX FEED PUMP BECAME INOP,THROTTLE VALVE UNLATCHED	WEAR ON TWO MATING SURFACES ON LINKAGE

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	DC2	0302798	012480	B	PT	B13		T	1	N	T	AUX FEED PUMP FAILED TO START	BURNED OUT RESET COIL ON TRIP & THROTTLE
W	DC2	030744	032180	B	PT	B13		T	1	M	T	AUX FEED PUMP TRIPPED AND T&T VALVE DIDN'T RESET	RESET SOLENOID DEFECTIVE,LINKAGE MISADJU.
W	DC2	031310	052080	B	PT	U13			1	N	U	AUX FEED PUMP TRIP THRO VALVE LINKAGE UNLATCHED	CAUSE OF UNLATCHMENT UNKN,PUMP IN STANDBY
W	DC2	032628	090480	L	PM	C06	U		1	T	D	EAST RHR PUMP WAS FOUND UNSTABLE	ALL AIR WAS NOT REMOVED FROM SERVICE
W	HN1	014163	012476	G	PM	A19			1	N	T	EXCESSIVE SEAL LEAKAGE ON 1A CENT CHARGING PUMP	OUTBD SEAL HAD "O" RING FAILURE
W	HN1	015097	061776	R	PM	D06	U		1	N	D	R/X SHUTDOWN & REFUELING LOST PWR TO RHR PMP--2MIN	OVERLOADED 480V BUS PROCEDURES DEFICIENT
W	HN1	015218*	070576	B	PT	C11	U		2	N	T	AUX FEED PMPS WOULD NOT DEVELOP PROPER DISCH PRESS	BOTH PUMPS VAPOR BOUND - FAULTY CHK VLV
W	HN1	016041	100176	I	PM	D21			1	N	T	1A BAT DEVELOPED LEAK IN CANNED ROTOR DUE TO BRNGS	WIPED BRNGS ALLWD ROTOR TO DROP & WEAR
W	HN1	017426	030477	I	PM	D09			1	N	T	1A BAT OVERHEATD & SEIZED DUE TO BEARING FAILURE	FOREIGN MATERIAL ENTERED MOTOR BEARING
W	HN1	017569	040477	G	PM	C20			1	N	T	"A" CHGNG PUMP INDICATIONS POINTED TO FAULTY OPS	DISASSY REVEALED CRKS UNDER PRESS RED SLV
W	HN1	017689	042677	G	PM	A05			1	M	D	1A CHG PMP DEVELOPED SMALL WEEP ON SUCT MECH SEAL	SLIGHT POROSITY BTWN SL SPLY PSG & SL SUR
W	HN1	017688	042877	G	PM	D20			1	N	T	1A CHARGING PMP AXIAL MISALIGNMNT OF MTR TO PUMP	EXCESS THRUST WIPED MOTOR BEARING RAN 20M
W	HN1	018911	082177	K	PM	A[illegible]			1	N	U	#2 RCP INDICATED SEAL FAILURE - SHUT DOWN	VIS INSP CONFMD SL FAILD - MOD# SU-4M-A1
W	HN1	021329	040378	H	PM	C14			1	M	U	"A" HPSI PMP DEVELOPED UNUSUAL DRAG DURING MAINT	INSPECTION DISCLSD CRKD WR RNGS & BSHNGS
W	HN1	025723	011879	B	PT	C11	S		1	T	D	"A" AUX FEED PUMP FAILED TO REACH RATED FLOW	OVERHEATED H2O SUPPLY TO PUMP
W	IP2	010282	051074	H	PM	B09	U		2	N	T	#23 & #21 HPSI PUMP STARTED ONLY DEVELOP 700# PRS	BORIC ACID LEAKAGE CAUSD SUCTION BLOCKAGE
W	IP2	010235	052274	B	PM	B13	S		1	N	D	NO. 21 AUX FD PUMP FAILED TO START - AUTOMATIC	AUTO START CKT SWITCH HAD DIRTY CONTACTS
W	IP2	012862	052275	L	PM	A16			1	N	D	RHR PMP #21 REMOVED FROM SERVICE TO REPAIR SEAL W	LEAKNG SEAL HEAT XCHGR - PMP MOD# 8X20W
W	IP2	013170*	072275	G	PM	A19	R		1	N	D	2 CHG PMPS REMOVED FROM SERVICE	EXCSV PLUNGER SEAL LEAKAGE
W	IP2	013299*	082775	G	PM	A19	R		1	N	D	2 CHG PMPS REMOVED FROM SERVICE	EXCSV PLNGR SEAL LKG.- VAR SPD 98GPM
W	IP2	013300*	082975	G	PM	A19	R		1	N	D	2 CHG PMPS REMOVED FROM SERVICE	EXCSV PLNGR SEAL LKG - PSBLE DESIGN MOD
W	IP2	013432	090475	I	PM	A19	R		1	N	T	BOR ACD XFER PUMP # 21 REMOVED FROM SERVICE-TYPE 1	BELLOW SHAFT SEAL LKG - DWG FSP 10443-2
W	IP2	013609	101475	I	PM	A19	R		1	M	T	BOR ACD XFER PUMP #22 REMOVED FROM SERVICE -TYPE 1	BELLOW SHAFT SEAL LKG - DWG FSP 10443-5
W	IP2	0137398	110575	G	PM	A16	R		1	N	D	NO. 23 CHG PUMP REMOVED FROM SERVICE	LEAKING HEAD GASKET - TYPE QX-300 QUNTPLX
W	IP2	0137399	110575	G	PM	A19	R		1	N	D	NO. 22 CHG PUMP REMOVED FROM SERVICE	EXCSV PLNGR SEAL LKG - TYPE QX-300 QUNTPX

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	IP2	013850	120375	G	PM	A16	R		1	N	D	NO. 21 CHG PUMP REMOVED FROM SERVICE	L<S HEAD GSKT - TYPE GX-300 QUINTUPLEX
W	IP2	014003A	121875	G	PM	A16	R		1	N	D	NO. 21 CHG REMOVED FROM SERVICE	PIN HOLE LEAK IN FLUID HEAD
W	IP2	0140038	121875	G	PM	A16	R		1	N	D	NO. 23 CHG REMOVED FROM SERVICE	LARGE LEAK IN FLUID HEAD
W	IP2	014449	031276	I	PM	A19	R		1	N	T	BOR ACD XFER PUMP REMOVED FROM SERVICE	BELLOW SEAL LKG - CRACKED ROT SEAL SURFCE
W	IP2	015920*	080576	H	PM	C03	N		3	T	D	ALL 3 SAFETY INJ PUMPS RUN APPX 10 MIN W/O SUCTION	CMN PUMP SUCTION VLV (846) NOT OPEN
W	IP2	0187878	050777	J	PM	B13	S		1	T	D	#22 AUX COMP COOL HTR PMP FAILD TO START DURIN SI	DIRTY CONTACTS ;PLANT IN COLD SHUTDOWN
W	IP2	018789	052577	L	PM	A19			1	N	T	#22 RHR PUMP REMOVED FROM SERVICE	MECH SEAL ASSY GSKT DETERAID AND LEAKED
W	IP2	019236	052677	G	PM	C15			1	N	U	#22 CHG PUMP DEVELOPED LOUD NOISE - LOST DISCH PRS	FLUID DRIVE CPLNG FOUND BROKEN
W	IP2	018331	070277	K	PM	A19			1	N	U	NO. 23 RX COOLANT PUMP TRIPPED OFF-LINE MANUALLY	SEAL PACKAGE FAILED, TOT LKG 90,000 GAL
W	IP2	019239	090977	I	PM	A19	R		1	N	T	#22 BOR ACID XFER PUMP REMOVED FROM SERVICE	TYPE 1, BELLOWS SHAFT SEAL WAS LEAKING
W	IP2	020822	121577	B	PM	D18			1	N	T	#23 AFP OOS DUE TO SPARKING MOTOR--MOTOR REPLACED	WESTINGHOUSE ,400BHP, DWG 8610800
W	IP2	021333	050278	J	PM	B00			1	T	U	NO. 22 AUX COMP COOLING PUMP FAILED TO START	CAUSE UNKNOWN, FOUND DOING SI SYS TEST
W	IP2	021706	060278	H	PM	D21			1	T	T	EXCESS OIL FROM SI PUMP NO. 22 THRUST BEARING	THRUST COLLAR AND SHOES FAILED,REPLACED
W	IP2	022721	090878	I	PM	A19	R		1	N	T	NO. 22 BORIC ACID TRANS PUMP DECLARED INOPERABLE	FAILED MECHANICAL SEAL
W	IP2	023580	121478	G	PM	A16	R		1	M	T	CH. PUMP #22 HAD LEAKAGE AROUND STUFF BOX GASKET	FOUND CRACK IN FLUID HEAD AND CYL. WALL
W	IP2	025227	020679	I	PM	D13	S		1	N	T	NO. 22 BORIC ACIC TRANSFER PUMP BECAME INOPERABLE	FAILED CONTROL TRANSFORMER
W	IP3	016944	011277	H	PM	B13	S		1	N	D	#33 SI PMP FAILD TO START FROM SIS;PLANT TRIP 100%	TD RELAY IN START CKT FAILD MODEL 2412PC
W	IP3	017878	040477	H	PM	C14			1	R	T	NO. 31 SAFTY INJ PMP HAD GRAD DETERAIN OF FLD DUPT	WORN INTERNALS - HIGH HEAD TYPE JTCH
W	IP3	017877	041277	B	PM	B15			1	N	U	ATTEMPT TO PUT #33 AUX FEED P**P ON-LINE UNSUCSFL	SHAFT HAD SHEARED - MOD 3HMTA-9
W	IP3	019265	092577	G	PM	A16	R		1	N	U	#32 CHG PUMP DEVELOPED LEAK IN HEAD - TAKEN OFF-LN	HAIR-LINE CRACK IN HEAD - 98 GPM, QX-300
W	IP3	019264	093077	G	PM	A19	R		1	N	U	#33 CHG PUMP TAKEN OUT OF SERVICE	EXCSV SEAL LEAKAGE - TYPE QX-300 QUINTPLX
W	IP3	019262	100177	G	PM	A19	R		1	N	U	#31 CHG PUMP TAKEN OUT OF SERVICE	EXCSV SEAL LEAKAGE - TYPE QX-300 QUINTPLX
W	IP3	019283	100577	I	PM	A19	R		1	N	U	#32 BOR ACID XFER PUMP REMOVED FROM SERVICE	LEAKING BELLOWS SHFT SL - CRANE,TYPE 1
W	IP3	019282	100677	I	PM	A16	R		1	N	U	#32 BOR ACID XFER PUMP REMOVED FROM SERVICE	LEAKING SUCTION FLANGE GASKET - MOD 3196
W	IP3	020122	121677	G	PM	A19	R		1	N	U	#33 CHG PUMP REMOVED FROM SERVICE	EXCSV SEAL LEAKAGE - 98GPM TYPE QX-300

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	IP3	021036	032878	L	PM	A16			1	N	U		#31 RHR PUMP REMOVED FROM SERVICE	GSKT BTWN GLND PLATE AND PMP CASING LKNG
W	IP3	021359	041678	G	PM	A19	R		1	N	U		#31 CHG PUMP REMOVED FROM SERVICE	EXCSV SEAL LEAKAGE - QX-300 QUINTUPLEX
W	IP3	022411	081578	R	PM	A19			1	N	T		NO. 32 RHR PUMP SEAL FOUND LEAKING	SEAL SURFACES FOUND WORN
W	IP3	022877	102778	G	PM	A14	R		1	N	T		LEAKAGE OBSERVED FROM NO. 31 CHARING PUMP	LEAK WAS FOUND IN PLUNGER
W	IP3	025232	020579	G	PM	A19	R		1	N	T		# 32 CHARGING PUMP DISCOVERED LEAKING	FAILED PLUNGER AND PACKING
W	IP3	026479	071579	I	PM	A19	R		1	N	T		#32 BORIC ACID TRANSFER PUMP DEVELOPED LEAK	MECHANICAL SEAL WAS REPAIRED
W	JF1	019847	120377	B	PT	B13	S		1	N	D		AFP TURBINE STARTED BUT FAILD TO REACH MAX SPEED	SIGNAL CONVERTER SSC-3405 FAILD
W	JF1	020993	032578	B	PT	B01	S		1	N	D		AFPT FAILD TO START FOLLOWING R/X TRIP	TRIP/THROTTLE VALVE FOUND SHUT
W	JF1	022633	090978	B	PT	B13			1	T	U		AUX FEED PUMP DID NOT START	TRIP THROTLE VALVE TRIPPED,UNKNOWN CAUSE
W	JF1	022631*	091778	F	PM	U01	U		2	N	D		BOTH CONTMT SPRAY PMP SUPPLY BREAKERS TAGGED OPEN	BOTH TRAINS REQUIRED BY TECH SPECS
W	JF1	025438	011679	B	PT	B13			1	N	T		AUX FEEDWATER PUMP FAILED TO START AFTER RX TRIP	MINT FLOW SPRING TENSION INSUFFICIANT
W	JF1	027639	110379	B	PT	D03	U		1	T	D		AUX FEED PUMP TRIPPED ON OVERSPEED	MANUAL SPEED ADJUST LEFT MISADJUSTED
W	JF1	030322*	021480	B	PM	B04	U		2	T	D		A&B AUX FEED PUMPS FAILED TO AUTO START	INADEQUATE DESIGN CHANGE CONTROL
W	JF1	030559	021580	B	PT	D02			1	T	D		AUX FEED PUMP DECLARED INOPERABLE,HOT THRUST BEAR.	MISPOSITIONED OILER ASSEMBLY,HI OIL LEVEL
W	JF1	030560	022280	B	PT	B13	S		1	N	T		WHILE STARTING AUX FEED PUMP THE TURBINE TRIPPED	TRIPPED OVERSPEED DUE TO LIMIT SWITCH
W	KE1	010646*	080174	A	PM	B03	U		2	T	D		TWO AFP'S DID NOT START UNTIL THIRD ATTEMPT	DID NOT ALLOW OIL PRESS TO BUILDUP
W	KE1	010644	081974	J	PM	B02	U		1	N	D		COMP COOL PMP 1A DID NOT START PM ON 8/16/74	CKT BKR NOT RACKED IN FULLY
W	KE1	010928	102574	B	PM	B13	S		1	N	D		1A AFP DID NOT START AUTOMATICLY ON HI WTR LEVEL	A.O. SMITH RELAY BOUND UP MECHANICALLY
W	KE1	012113	010475	B	PM	B00			1	N	U		2A AFP FAILD TO START AFTER R/X TRIP	UNDER INVESTIGATION
W	KE1	012110	012475	B	PM	B04	T		1	N	D		1A AFP FAILD TO START ;POWER SUPPLY FAILURE	BKR OPERATING HANDLE DID NOT CONTACT
W	KE1	012399	020775	B	PM	B04	T		1	N	D		1A AFP FAILD TO START ON LO-LO SG LEVEL	BKR GUIDE BAR"POSITION" NOTCH TOO SMALL
W	KE1	013499A	101575	B	PM	B13	S		1	N	D		1A AFP FAILD TO START FOLLOWING A UNIT TRIP	DEFECTIVE W-2 SWITCHES
W	KE1	013499B	101575	B	PT	B13	S		1	N	D		1C AFP FAILED TO START FOLLOWING UNIT TRIP	DEFECTIVE WESTINGHOUSE W-2 SWITCH
W	KE1	013667*	110575	B	PM	C04	S		3	N	D		AFP 1A,1B& 1C REDUCED FLOW DUE TO STARTUP STRAINRS	PLUGGD BY RESIN BEADS FROM MAKEUP DEMIN
W	KE1	013773	120475	B	PM	B00	S		1	N	U		BKR 16201 OPENED CAUSING UNIT TRIP & INOP. 1B AFP	BKR 16201 CLOSED MANUALLY

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	KE1	014386	031276	B	PM	B13		S	1		T	D	AUX FD PUMP 1A FAILED TO START ON BLACKOUT SEQ SIG	FAULTY LUBE OIL PRESSURE SWITCH
W	KE1	016117	092776	B	PM	B13		S	1		T	D	1B AFP FAILD TO START DUE TO STICKY ACTUAT. RELAY	WORN PLUNGER SHAFT,REPLACED RELAY
W	KE1	016696	122276	I	PM	D00			1		N	U	BOR ACID PUMP 1A TRIPPED AND WOULD NOT RESTART	BKR OVLDS TRIPPED, RESET - NO OTHR PROBLM
W	KE1	018882	081777	J	PM	B13		S	1		M	D	COMP COOL PMP WOULD NOT START AFTER PM WORK DONE	TRIP ARM HITTING TRIP ROD;READJUSTED,LUBE
W	KE1	019311	100277	G	PM	D18		R	1		N	D	FLOW FROM OPERATING CHG PMP WAS LOST DURING OPERTN	BROKEN BELT ON VARI-DRIVE UNIT
W	KE1	019313	100777	F	PM	B00		R	1		T	D	SPRAY PMP FAILD TO START DUE TO OVERCURRENT TRIP	START CURRENT G.T. SETPOINT; RAISED SETPT
W	KE1	019518	102477	F	PM	B00		R	1		N	D	A CONTAINMT SPRAY PUMP FAILED TO START DURING TSTG	CAUSE UNKWN - BKR WAS TRIPPED ON OVRCURNT
W	KE1	019643	110777	G	PM	D18		R	1		N	D	FLOW FROM OPERATING CHG PMP WAS LOST DURING OPER	BROKEN BELT ON VARI-DRIVE UNIT
W	KE1	020094	122377	F	PM	B00		R	1		T	D	ICS PMP 1B FAILED TO START DURING OPERATIONAL TEST	CAUSE UNKNOWN - BRKR OPERTG ERRATICALLY
W	KE1	020339	011578	J	PM	B13		S	1		N	D	CC PUMP FAILD TO START DURIN FULL POWER OPERATION	FAULTY STATIC TRIP DEVICE IN CKT BREAKER
W	KE1	020338	011878	J	PM	B00			1		N	U	CC PUMP FAILD TO START DUE TO OVERCURRENT TRIP	UNDER INVESTIGATION CAUSE NOT DETERMINED
W	KE1	022237	080978	G	PM	C13		S	1		N	T	CCP OPERATED ONLY AT HIGH SPEED	FAILED TRANSISTOR IN HAND CONTROL STATION
W	KE1	022540	091878	G	PM	A16			1		N	T	LEAK DEVELOPED ON CCP BETWEEN DIS. PIPE AND BLOCK	CRACK CAUSED BY OPERATING STRESS
W	KE1	030562	021180	G	PM	D13		S	1		N	T	CHARGING PUMP STOPPED WHEN CONTROL SW PLACED AUTO	STICKING CONTACT
W	NA1	021636	053078	K	PM	D07			1		N	T	RCP C REQUIRED TO BE SECURED	LEAK IN LOWER LUBE OIL COOLER ;
W	NA1	021665	060678	F	PM	B09		S	1		T	D	CONT QUENCH SPAY PUMP 1-QS-P-1A FAILED TO START RE	SCREW FOUND IN SUPPLY BKR (FOREIGN)
W	NA1	021890	061578	F	PM	B13		S	1		T	D	QUENCH SPRAY PUMP 1-QS-P-1B FAILED TO START	BKR CHR SPRING MOTOR SWITCH IN OFF POSI.
W	NA1	022033	071778	G	PM	D02			1		N	D	CHP PUMP 1C BECAME INOPERABLE	IMPROPERLY ASSEMBLED SEAL ASSEMBLY
W	NA1	025755	033079	B	PT	D13		R	1		N	U	AUX FEED PUMP 1-FW-P-2 TRIP THROTTLE VLV CLOSED	SIGNAL FROM OVERSPEED TRIP
W	NA1	025716	040879	G	PM	U01		U	1		N	D	1A&1B OOS FOR MAINT, 1C FEEDER BRKR NOT RACKED IN	IMPROPER TAGOUT PROCEDURE
W	NA1	027080	090479	B	PM	D09			1		N	T	AUX FEED PUMP BECAME INOPERABLE (1-FW-P-3)	LUBE OIL STRAINER WAS CLOGGED
W	NA1	027248	092879	G	PM	C00			1		T	U	CHARGING PUMP 1-CH-P-1A DID NOT FUNCTION	CAUSE NOT STATED
W	NA1	030102	011380	B	PT	D21			1		M	T	AUX FEED PUMP TAKEN OUT OF SERVICE FOR INSPECTION	BEARING HAD WIPED,DUE TO LACK OF OIL
W	NA1	030101	011480	B	PT	D18			1		N	T	AUX FEED PUMP 1-FW-P-2 DEVELOPED LEAK IN OIL COOL.	BLOWN GASKET
W	NA1	032635	090880	B	PT	D13		R	1		N	U	AUX FEED PUMP GOVERNOR VALVE FOUND TRIPPED	GOVENOR TRIPPED ON OVERSPEED,CAUSE UNKNO.

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	PR1	010725	081374	B	PM	B13		S	1		T	D	AUX FEED PUMP 12 FAILED TO START	BRKR FOR AUX LUBE OIL PUMP WAS OPENED
W	PR1	011230	121274	B	PM	C09		S	1		N	T	AUX FEED PUMP 12 DID NOT MAINTAIN NORMAL DISCH FLO	SUCTION STNR CLOGGED WITH SILT
W	PR1	012411	032775	B	PT	B09			1		N	D	TURB DRVN AUX FD PMP FAIL TO REACH ACCPT DISCH PRS	STICKY GOV CONT VLV LINKAGE - DIRTY
W	PR1	017619	041177	H	PM	D04			1		T	D	#12 SAFTY INJ PMP #7IMPELLR MOVED AXIALLY ON SHAFT	ABNORMAL PRESSURE DISTRBTION ACROSS IMPLR
W	PR1	017791	050177	B	PT	B06			1		N	D	#11 TURB AUX FD PMP TRIPPD TWICE ON OVERSPEED	LOW GOVERNR OIL LEVEL REVISED PROCEDURES
W	PR1	019807	062877	G	PM	D13			1		N	U	CHARGING PUMP FAILED	CAPSCREW FAILURE IN VARIDRIVE UNIT
W	PR1	028041	122878	B	PT	D13	U		1		T	D	NO. 11 AUX FD PUMP TRIPPED OFF-LINE AT END OF TEST	STEAM SUPPLY VALVE TRIPPED ON OVERLOAD
W	PR1	026014	040879	H	PM	B00			1		T	U	#11 SAFETY INJECTION PUMP FAILED TO START IN AUTO	UNKNOWN CAUSE,EVENT COULD NOT BE REPEATED
W	PR2	019896	111077	B	PT	B13			1		T	T	#22 TURB DRVN AUX FD PMP TRIPPED ON OVERSPEED	LOOSE LINKAGE ON GOV TO PRESS COMPENSATOR
W	PR2	021038	041778	L	PM	U01	U		1		N	D	OPERATOR PLACED #22 RHR PUMP OOS - AUX OPER OPENED	CKT BRKR FOR # 21 RHR PUMP - PERSONNEL ER
W	PR2	027527	110279	B	PT	B13			1		T	U	#22 AUX FEED PUMP FAILED TO START	OVERSPEED TRIP VALVE FOUND TRIPPED
W	PR2	030733	031280	G	PM	B13		S	1		N	D	NO. 22 CHR PUMP MOTOR BKR KEPT TRIPPING	BREAKER FAILURE, BKR REPLACED
W	PR2	031455	052980	B	PT	D02		T	1		N	D	NO. 22 AUX FEED PUMP TRIPPED INADVERTANTLY	TECH DROPPED INST ON TRIP THROTTLE LINKAG
W	PR2	031631	061590	G	PM	B13		S	1		N	D	NO. 23 CHR PUMP STARTED AND SOON SHUTDOWN	AIR LEAKS IN SPEED CONTROL UNIT
W	PR2	032731	091680	B	PT	D02		T	1		N	D	AUX FEED PUMP TRIP MECHANISM WAS TRIPPED	WORKMAN ACCIDENTLY BUMPED TRIP MECHANISM
W	PT1	000964A	040774	B	PM	C09		S	1		U	T	"A" MTR DRIVEN AUX FD PUMP HAD INADEQUATE FLOW	IN-LINE CONICAL STRAINER WAS PLUGGED
W	PT1	000964B	040774	B	PM	U09		S	1		U	T	"B" MTR DRIVEN AUX FD PUMP WD HAVE HAD INAD FLOW	IN-LINE CONICAL STRAINER WAS PLUGGED
W	PT1	010648	062174	F	PM	B13		T	1		U	D	CONTAINMENT SPRAY PUMP 1P14A DID NOT START	PUMP BRKR LATCH WAS NOT FULLY ENGAGED
W	PT1	012531	041875	B	PT	A19			1		U	U	8 GALS LOW LEVL RAD. WTR LEAKD VIA STEAM-DR AUX FD	SHAFT GLANDS LEAKD SHUT DISCHRG VALVE
W	PT1	016772*	030876	G	PM	D18		R	2		N	T	CHARGING PUMPS "B" AND "C" FAILED	BROKEN VARIDRIVE BELTS - VARIBELT NO. 842
W	PT1	016709	123076	G	PM	A19			1		N	T	C CHRGNG PMP OOS DUE TO PLUNGER LEAKAGE	PACKNG WEAR AJAX IRON WORKS TYPE T-125
W	PT1	021765*	063078	F	PM	B13		T	1		N	D	CONTAINMENT SPRAY PUMP 1-P14B DECLARED OOS	POWER SUPPLY BKR WOULD NOT RACK IN
W	PT1	027043	091279	G	PM	C16		R	1		U	D	THE 1-P2B CHR PUMP FOUND TO HAVE CRACKED CYL BLOCK	PRESSURE SPIKING FOLLOWING H2 SEPARATION
W	PT2	017248A	022176	G	PM	A19		R	1		N	T	2P2C CHARGING PUMP TAKEN OUT OF SERVICE	REPAIR PLUNGER LEAKAGE
W	PT2	017248B	022176	G	PM	D18		R	1		N	D	2P2B CHARGING PUMP FAILED	BROKEN VARIDRIVE BELT - VARIBELT NO. 842

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	PT2	0161154A	092076	G	PM	A19		R	1		N	T	"C" CHARGING PUMP TAKEN OUT OF SERVICE	REPAIR MINOR PLUNGER LEAKAGE
W	PT2	0161548	092076	G	PM	D18		R	1		N	D	"B" CHARGING PUMP FAILED	BROKEN VARIDRIVE BELT - VARIBELT NO. 842
W	PT2	020461A	022177	G	PM	A19		R	1		N	T	2P2C CHARGING PUMP TAKEN OUT OF SERVICE	REPAIR PLUNGER LEAKAGE
W	PT2	0204618	022177	G	PM	D18		R	1		N	D	2P2B CHARGING PUMP FAILED	BROKEN VARIDRIVE BELT - VARIBELT NO. 842
W	PT2	020713D	040677	G	PM	C04		R	1		U	T	CHR PUMP "C" DISCOVERED TO HAVE CYC BLOCK CRACK	PULSATIONS CAUSED CRACKING
W	PT2	017722	042077	G	PM	C00			1		N	U	CHRGNG PMP UNABLE TO DELIVR SUFFCNT FLOW	NOT YET DETERMINED INVESTIGATIONS CONT
W	PT2	017839	051677	G	PM	B21			1		N	U	2P2B CHRGNG PMP OOS DUE FOR INSPECTION OF NOISY BR	BRNG FOUND SERVICEABLE
W	PT2	0207138	022878	G	PM	C04		R	1		M	T	CHR PUMP "B" DICCOVERED TO HAVE A CYL BLOCK CRACK	INSTLLTN OF PULSATION DAMPNERS PLANNED
W	PT2	020713C	030178	G	PM	C04		R	1		M	T	CHR PUMP "C" DISCOVERED TO HAVE A CYL BLOCK CRACK	INSTLLTN OF PULSATION DAMPNERS PLANNED
W	PT2	020974	031378	G	PM	D18		R	1		N	T	A CHRGING PMP OOS TO REPLACE BELT	BROKEN VARIDRIVE BELT
W	RG1	001037	061173	H	PM	B13		T	1		T	D	SAFETY INJECTION PUMP 1C FAILED TO START	BENT OPERATOR ARM ON THE CELL SWITCH
W	RG1	000629*	121473	B	PM	C11		U	2		T	D	AUXILIARY FEED PUMPS A & B LOST SUCTION	AIR IN SUCTION HEADER
W	RG1	010046	040674	H	PM	B13		T	1		T	D	1C SAFETY INJECTION PUMP FAILED TO START MANUALLY	PREMATURE CLOSING OF CB TRIP BAR
W	RG1	010664	080774	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 16	MAY BE FAULTY LOCKOUT INTERLOCK
W	RG1	012115	010875	B	PT	B13		S	1		T	D	TURBINE-DRIVEN AUX FD PUMP FAILED TO START SUCSFLY	LO LUBE OIL PRESS REGULATOR SETTING
W	RG1	012136A	020575	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 16	REP WEAK SPRING AND TIGHTENED WIRE IN CB
W	RG1	0121368	020675	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 16	REP WEAK SPRING AND TIGHTENED WIRE IN CB
W	RG1	012397	02.875	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 16	MECH BINDING ON LOCKOUT SOLENOID PLUNGER
W	RG1	013996	011276	J	PM	D15			1		N	T	"B" COMPONENT COOLING WATER PUMP WAS NOISY	DAMAGED COUPLING - LOOSE BOLTS, MOD DBZ 226
W	RG1	016716	010377	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 14	WEAK SPRING IN SECONDARY CONTACT ASSY
W	RG1	018225	061977	G	PM	D18		R	1		N	T	"C" CHARGING PUMP VARIDRIVE FOUND SMOKING	BELTS REPLACED - VARIDRIVE PART 84-2
W	RG1	018244	062977	H	PM	B13		T	1		T	D	1C SAFETY INJ PUMP FAILED TO START ON BUS 14	NO APPARENT CAUSE FOR CB FAILURE
W	RG1	021670	052978	F	PM	B13		S	1		T	T	CSI PUMP FAILED TO START	FAILED CIRCUIT BKR
W	RG1	025064	010479	G	PM	A16			1		N	T	'A' CHARGING PUMP FOUND LEAKING	BLOCK REPLACED, HIGH HOOP STRESSES
W	RG1	025065	010479	G	PM	C18		R	1		N	T	'B' CHARGING PUMP SPEED CONTROL NOT OPERATING PROP	VARIDRIVE BELT SLIPPING AT LOW SPEEDS

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	R02	002067	060772	F	PM	B14			1		U	U	ONE OF THE CONTAINMT SPRAY PMPS FOUND TO BE BINDNG	BURR ON IMPELLER GALLED THE SEAL RING
W	R02	000184*	070973	H	PM	B02	U		2		U	D	SAFTY INJECTION PMPS "B"&"C" TRIPPD ON MANUAL STAR	INSTANTNS TRIP SETTINGS WERE SET AT MIN.
W	R02	000185	070973	B	PM	B13	S		1		U	D	AFP "B" TRIPPD ON INITIAN OF MANUAL START	AFP "B" TRIPPD ON INITIAN OF MANUAL START
W	R02	000609	120473	I	PM	D04	R		1		U	T	BORIC ACID XFER PMP B SHAFT BROKE AT IMPELLER	GENERIC DESIGN PROBLEM - TYPE GE-20K
W	R02	000898	032074	I	PM	D04	R		1		N	D	BORIC ACID XFER PMP B BKR TRPD ON THERMAL OVLD	PUMP HAD BROKEN SHAFT - DESIGN PROBLEM
W	R02	010112	032074	I	PM	D00	R		1		N	U	BORIC ACID XFER PMP B FOUND TRIPPED ON ROUTINE INS	CAUSE UNKNOWN
W	R02	010091	040674	I	PM	D04	R		1		N	D	BORIC ACID XFER PUMP A FAILED DURING NORMAL OPER	SHAFT BROKE IN VICINITY OF IMPELLER
W	R02	010476	080874	I	PM	D04	R		1		N	D	BORIC ACID XFER PUMP B FAILED DURING 100% PWR OPS	PUMP SHAFT BROKEN - DESIGN PROBLEM
W	R02	010519	081574	I	PM	D04	R		1		T	D	BORIC ACID XFER PUMP B FAILED DURING PERIODIC TEST	PUMP SHAFT FAILED - DESIGN PROBLEM
W	R02	010603	092674	I	PM	D04	R		1		N	D	BORIC ACID XFER PUMP B FAILED DURING 100% PWR OPS	PUMP SHAFT BROKE AT JUNCTURE WITH ROTOR
W	R02	011033	111974	B	PT	D02	S		1		T	D	STEAM DRIVEN AFW PUMP TRIPPED ON OVRSPD DRNG TEST	WOODWARD GOVNR MAN STTG OUT OF ADJUSTMENT
W	R02	011088	120474	I	PM	D21	R		1		U	D	BORIC ACID XFER PUMP B FAILED AT PUMP-ROTOR END	MAY BE CAUSED BY BEARING WEAR
W	R02	012078	011475	I	PM	D04	R		1		N	D	BORIC ACID XFER PMP A FAILED DURING 100% PWR OPS	PUMP SHAFT FAILED - DESIGN ERROR
W	R02	012300	012675	J	PM	D13	S		1		N	D	OVERCURRENT TRIP OF "C" COMP. COOLN WTR AT 100% PW	FAILD STATUS LITE;TRIED SEVERAL STARTS
W	R02	012680	050175	K	PM	A19			1		N	U	REACTOR COOLANT PUMP LOST BOTH SHAFT SEALS	SEAL FAILURE - PUMP MODEL V11001-81
W	R02	012738	052175	I	PM	D04	R		1		N	D	BORIC ACID XFER PMP B STOPPED SHORTLY AFTER START	PUMP MOTOR SHAFT BROKEN - DESIGN PROBLEM
W	R02	012975	062575	I	PM	D04	R		1		N	D	BORIC ACID XFER PMP A FAILED DURING NORMAL OPS	PUMP SHAFT FAILED AT KEYWAY - DESIGN PROB
W	R02	013685	110275	B	PM	B13	S		1		T	T	"A"AFP FAILD TO START ON SIS;3 TARNISHED CONTACTS	HIGH HUMIDITY MAY BE FACTOR FOR TAR. CONT
W	R02	014820	010276	I	PM	D21	R		1		N	T	BAT "B" FAILD DAMAGED ROTOR---SERIES G,MODL GE-20K	FAILD REAR GRAPHITE BEARING
W	R02	014830	041276	I	PM	D02	T		1		N	D	"B" BAT PUMP TRIPPD AT 100% PWR	HEATER TRIPS SET AT 250 DEG F
W	R02	016205	091876	I	PM	D18	R		1		N	T	BAT "B" FAILD HI TEMP CUTOUT TRIPPD PUMP	DEFECTIVE STATOR AND BEARINGS WORN
W	R02	016259	102976	I	PM	D02	T		1		N	D	BATP B TRIPPED ON HI PUMP MOTOR TEMP CUTOUT	HEAT TRACING CIRCUIT TEMP SET TOO HIGH
W	R02	017098	012477	I	PM	D09			1		N	D	BATP B TRIPPED ON HI MOTOR TEMP CUTOUT	RECIRC LINE PLUGGED WITH SOLID BORIC ACID
W	R02	017099	013177	I	PM	D02	S		1		N	D	BATP B TRIPPED ON HI MOTOR TEMP CUTOUT	TEMP CUTOUT SET TOO LOW FOR NORMAL OPS
W	R02	017585	032477	F	PM	U02	S		1		N	D	CONTMT SPRAY PMP A NOT ON SVC DURING CRITICALITY	PERSONNEL HAD REMOVED PUMP FROM SERVICE

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	R02	018138*	060777	G	PM	C11	V	2	N	D		B & C CHGNG PUMPS RUNNING - PSZR LVL STILL FALLING	PUMP AIR BOUND - TYPE TX-150
W	R02	019345	062277	G	PM	C11	V	1	N	D		"C" CHGNG PMP WOULD NOT CONTROL PSZR LEVEL	PUMP WAS AIR BOUND - TYPE TX-150
W	R02	019793A	112377	H	PM	U01	N	3	N	D		BREAKERS FOR ALL 3 SAFETY INJ PMPS FOUND RAKD OUT	FAILURE TO RECOG TS LIMIT FOR GT 200 F OP
W	R02	019793B	112377	F	PM	U01	N	2	N	D		BREAKERS FOR BOTH CONT SPRAY PMPS FOUND RAKD OUT	FAILURE TO RECOG TS LIMIT FOR GT 200 F OP
W	R02	020181	122277	B	PT	D11	S	1	T	D		AFPT TRIPPD DURIN TEST RUN; HI PUMP CASING TEMP.	STEAM LEAKAGE BACK THRU VALVE V2-14C
W	R02	022615	041178	B	PM	B13	S	1	N	D		"B" AFP FAILED TO START UPON LOSS OF MAIN FEED PRS	WORN CKT BKR TRIP ARM
W	R02	021317	041378	B	PM	B13	S	1	N	D		"B" AFP FAILD TO START FROM RTGB	INST. TRIP COILS SETTINGS FOUND TO BE LOW
W	R02	022614*	100378	F	PM	C06	U	2	T	D		BOTH OF THE CONTAINMENT SPRAY PUMPS FOUND AIRBOUND	PUMPS NOT VENTED AFTER SYSTEM REALIGNED
W	R02	023816	040279	I	PM	D15		1	N	T		BORIC ACID TRANSFER PUMP KEPT TRIPPING, PUMP "B"	BROKEN SHAFT, PUMP REPLACED
W	R02	026063	041479	H	PM	B00		1	T	U		"A" SI PUMP FAILED TO START	CAUSE UNKNOWN
W	R02	026362	060479	B	PM	B18		1	N	D		"A" AFW PUMP TRIPPED SHORTLY AFTER STARTING	ROTOR BARS CRACKED IN MOTOR
W	R02	032732	081180	H	PM	B13	S	1	T	T		"A" SI PUMP BKR FAILED TO CLOSE	HIGH RESISTANCE ALARM SWITCH CONTACT
W	SA1	016938	010877	B	PT	B01	U	1	N	D		#13 AUXILIARY FEEDWATER PUMP FAILED TO START	PERSONNEL ERROR - TURB WAS MANUALLY TRIPD
W	SA1	017700A	050677	H	PM	U01	U	2	R	D		BOTH SI PUMPS AND 1 CENTRIFUGAL CHG PMP TAGGED OUT	PERSONNEL ERROR - NOT FOLLOWING PROCEDURE
W	SA1	017700B	050677	G	PM	U01	U	1	R	D		BOTH SI PUMPS AND 1 CENTRIFUGAL CHG PMP TAGGED OUT	PERSONNEL ERROR - NOT FOLLOWING PROCEDURE
W	SA1	022422	082478	B	PT	B13		1	T	U		AUX FEED PUMP FAILED TO START	STEAM INLET VALVE OP SHEAR PIN WAS MISSED
W	SA1	022871*	102178	K	PM	A06		1	N	D		ALL THREE RCP SEALS FAILED	POSSIBLY TOO HIGH A DIFFERENTIAL PRESSURE
W	SA1	023232A	112778	G	PM	B13	T	1	N	T		NO 11 CHR PUMP FAILED TO START DURING SI	BUS FAILURE DUE TO OUTPUT TRANSF FAILED
W	SA1	023232B	112778	L	PM	B13	T	1	N	T		NO 12 RHR PUMP FAILED TO START DURING SI	BUS FAILURE DUE TO OUTPUT TRANSF FAILED
W	SA1	023232C	112778	B	PM	B00	S	1	N	T		NO 12 AUX FEED PUMP FAILED TO AUTO START DURING SI	NO CAUSE GIVEN. (STARTED MANUALLY)
W	SA1	023232D	112778	B	PM	B13	S	1	N	T		NO 13 AUX FEED PUMP FAILED TO START DURING SI	OVERSPEED TRIP MISADJUSTED
W	SA1	023316	121378	B	PT	D13	S	1	N	U		NO 13 AUX FEED PUMP TRIPPED ON OVERSPEED	SPEED CONTROL FOUND SET TOO HIGH
W	SA1	0281194	042479	R	PM	D06	V	1	N	D		OPERATING RHR PUMP TRIPPED OFF OF LINE	INADEQUATE WORKING PROCEDURES
W	SA1	0281198	050879	R	PM	D06	V	1	N	D		OPERATING RHR PUMP TRIPPED OFF OF LINE	INADEQUATE WORKING PROCEDURES
W	SA1	026013	060179	J	PM	C05	R	1	R	T		#13 COMPONENT COOLING WATER PUMP DP DEGRADING	#13 COMPONENT COLLING WATER PUMP DP DEGRA

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	SA1	028006	112879	H	PM	B14		R	1	N	D		SI PUMP FAILED,LOOSE LOCKNUTS FOUND,SHAFT BENT	REVERSE ROTATION POSSIBLE CAUSE,#12 PUMP
W	SA1	028073	122779	K	PM	D13		S	1	N	D		#12 RC PUMP TRIPPED	1E 4KV GROUP BUS WAS LOST
W	SA1	028119C	063080	R	PM	C04		U	1	N	D		RHR PUMP LOST SUCTION	LOW LEVEL LIMIT WAS TOO LOW FOR RX WA LE
W	SO1	018000	042677	I	PM	B09			1	N	T		NORTH BORIC TRANFR PMP(G-9A) FAILD TO START	PMP SEIZD DUE TO ACCUMLTN OF BORIC CRYSTL
W	SO1	027965	122679	B	PT	D21			1	T	T		AUX FEED PUMP FAILED	BEARING FAILURE CAUSED BY LACK OF LUB.
W	SO1	030015	011680	K	PM	D16			1	N	U		FIRE STARTED ON RCP "A" FROM AN OIL LEAK	NO CAUSE GIVEN FOR OIL LIFT PUMP OIL LEAK
W	SO1	030728	031880	G	PM	D21			1	N	T		HIGH TEMP IND ON SOUTH CHR PUMP'S THRUST BEARING	LOOSE COUPLING CAUSED BEARING TO BE WIPED
W	SU1	002022	111072	G	PM	A19			1	U	U		EXCESSVE SEAL LEAKAGE ON "A" CHARGING PUMP	SEAL DAMAGED
W	SU1	010417	113073	K	PM	D05			1	N	D		RCP 1A SHAFT FAILD AT 42% POWER	FILLET GROOVE ON SHFT INCORRECTLY MADE
W	SU1	000916	012374	R	PM	D18			1	N	T		MOTOR ON RHR PUMP 1-RH-P-1A BURST INTO FLAMES	INSUFFICIENT LUBRICATION TO LWR RAD BRNG
W	SU1	010373	051274	I	PM	D18			1	N	T		BORIC ACID TRANSFER PUMP MOTOR FAILED	GREASE ON STAT WNDGS CAUSED INSUL FAILURE
W	SU1	017137	020877	J	PM	D21			1	U	T		CHRG WTR PMP 1-CC-P-2A HAD TRIPPED ON THERMAL OVLD	MTR BRNGS ABRADED
W	SU1	021521	051078	F	PM	D09			1	T	D		INSIDE RECIRC SPRAY PUMP RS-P-1A FAILED TO ROTATE	FOREIGN MAT. BETWEEN IMPELL AND WEAR RING
W	SU1	022641	100978	J	PM	D21			1	N	T		CHR PUMP COMP COOLING WATER PUMP TRIPPED ON OL	MOTOR BEARINGS FAILED DUE TOO CORROSION
W	SU1	027758	121979	K	PM	D18			1	N	T		1A REACTOR COOLANT PUMP TRIPPED	GROUND FAULT IN PUMP MOTOR
W	SU1	030258	012380	I	PM	D02			1	N	D		FLOW WAS LOST FROM "A" BORIC ACID TRANSFER PUMP	SHAFT BROKE DUE TO PREVIOUS ASSEMBLY
W	SU2	000519	111373	H	PM	B02		U	1	U	D		SAFETY INJ/CHG PUMP 2-CH-P-1B DID NOT START-MANUAL	FUSES WERE NOT INSTALLED IN CONT CIRCUITS
W	SU2	013593	101575	I	PM	D18			1	N	T		"D" BORIC ACID TRANSFER PUMP MOTOR FAILED	BORIC ACID IN STATOR WINDINGS
W	SU2	017055	011877	I	PM	D15			1	N	U		BORIC ACID TRANSFER PUMP 1-CH-P-2D FAILED	MOTOR-TO-PUMP COUPLING WAS BROKEN
W	SU2	019742	111377	J	PM	B07			1	N	T		CHRG PMP COMP COOLING PMP 2B INOPERATIVE	NORMAL WEAR, PUMP REBUILT
W	SU2	020813	030178	I	PM	D21			1	N	T		BORIC ACID TRANS PMP 1-CH-P-2 TRIPD ON THERML OVRL	OUTBOARD BRNG FAILING
W	TR1	013977	121975	B	PD	B06	T		1	N	D		DIESEL DRIVEN AUX FD PMP FAILED TO START - MANUAL	PROCEDURES INADEQ TO ENSURE SYS START L/U
W	TR1	013976	010476	B	PD	D13	T		1	N	D		DIESEL-DRVN AUX FD PUMP TRIPPED ON OVERSPEED	FORK SIGNAL LEAD TO GOV VIBRATED LOOSE
W	TR1	014564	010976	B	PD	B13	T		1	T	D		DIESEL AFP OVERSPED WHEN MANUALY STARTED	GOVENR GAIN INCREASD TO IMPROVE RESPONSE
W	TR1	014145A	011676	B	PD	B01		U	1	N	D		AUX FEED PUMPS FAILED TO START AUTOMATICALLY	MISLOGGING OF LIFTED LEAD IN AUTO-STA CKT

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	TR1	0141458	011676	B	PT	B01		U	1		N	D	AUX FEED PUMPS FAILED TO START AUTOMATICALLY	MISLOGGING OF LIFTED LEAD IN AUTO-STA CKT
W	TR1	014251	012376	B	PD	B13		T	1		T	D	COLD STARTS OF DIESEL DRIVEN AUX FD PMPS UNSUCCSFL	CONT CKT FOR L.O. PRESS S/D NEED REDESIGN
W	TR1	0140678	012576	J	PM	B13		T	2		T	D	COMP COOLING WTR PMPS DID NOT START AUTOMATICALLY	SEQ CONT RATED AT TOO HI AMPACITY
W	TR1	0140678	012576	G	PM	B13		T	1		T	D	B TRAIN CHARGING PUMP(S?) DID NOT START	SEQ CONT RATED AT TOO HI AMPACITY
W	TR1	014566	031276	R	PM	D13		S	1		T	D	OPERATING RHR PUMP LOST POWER	CKT SWITCHER SUPP ESF BUS INADV OPENED
W	TR1	014571	032876	B	PD	B13			1		N	U	DIESEL DRIVEN AUX FD PUMP STARTED - TRIPPED, OVERSP	GOV MOD D 153-005A REP W MOD T 153-005A
W	TR1	014932	051276	B	PT	B13		T	1		N	D	STM DRIVEN AUX FD PUMP FAILED TO START	TRIP/THTL VLV NOT RESET-FAULTY IND LITE
W	TR1	016003A	090276	B	PD	D13		T	1		N	T	DIESEL-DRIVEN AUX FD PMP TRIPPED-HI HAKET WTR TEMP	TEMP SWITCH SET POINT SETTING DRIFTED LOW
W	TR1	015996	090376	B	PD	B13		S	1		N	D	DIESEL-DRIVEN AUX FEED PUMP FAILED TO AUTO-START	BLOWN FUSE IN THE AUTO-START CIRCUIT
W	TR1	0160038	090976	B	PD	D13		T	1		N	T	DIESEL-DRIVEN AUX FD PMP TRIPPED HI JAKET WTR TEMP	TEMP SWITCH SET POINT SETTING DRIFTED LOW
W	TR1	016339	100576	B	PT	D13		T	1		T	T	TURBINE-DRIVEN AUX FD PUMP TRIPPED ON OVERSPEED	FAILURE OF WOODWARL GOV SPD SENSOR CARD
W	TR1	016337	101976	B	PT	B01		S	1		N	D	TURB-DRVN AUX FD PMP FAILED TO START - AUTOMATIC	OPERATOR FAILED TO RESET TRP/THTL VALVE
W	TR1	017572	030277	H	PM	B13		T	1		N	D	ONE OF TWO SAFETY INJ PUMPS FAILED TO START	IMPROPER ACTUATION OF DBA SEQ CONTACTS
W	TR1	017574	032477	B	PD	D14			1		N	T	DIESL AFP TRIPPD ON LOW L.O. PRESS	BROKEN CRANKSHAFT ON DIESEL
W	TR1	018168A	052877	H	PM	B13		T	1		T	D	B SAFETY INJ PUMP DID NOT START - AUTOMATIC	SEQUENCER CONTACTS OPER WITH TOO LOW CRNT
W	TR1	018168C	052877	R	PM	B13		T	1		T	D	B RHR PUMP DID NOT START - AUTOMATIC	SEQUENCER CONTACTS OPER WITH TOO LOW CRNT
W	TR1	018452	070177	G	PM	D14			1		N	U	SOUTH CENTRFGL CHRG PMP ROTOR FAILD	DETAILD ANALYSIS UNDERWAY
W	TR1	018905	072877	J	PM	B00		T	1		T	U	B COMP COOLING WTR PUMP FAILED TO START - AUTO	EXACT CAUSE UNKNOWN-REPLACED ALL SEQNCRS
W	TR1	018991*	082177	K	PM	D01		N	4		N	D	POWER TO RCPS INADVERTENTLY DEENERGIZED	GEN OUTPUT BRKR WAS TRIPPED PREMATURELY
W	TR1	020182	121777	B	PD	B13		T	1		U	D	DSL DRVN AUX FD PUMP STARTED AND IMMED TRPD-HRSPD	MICROSWTCH IN SPD SENSING CKT OUT OF ADJ
W	TR1	020183	121777	B	PT	B13		S	1		U	D	STEAM DRIVEN AUX FEED PUMP INOPERABLE	LIMIT SW FAILURE IN OVERSPEED TRIP CKT
W	TR1	032078	072080	B	PT	B06		S	1		U	D	AUX FEED PUMP FAILED TO START MANUALLY	POOR PROCEDURE
W	TR1	032622	090380	B	PD	B18		S	1		T	T	AUX FEED PUMP FAILED TO START	FAILED STARTING BATTERY
W	TU3	000345	031973	J	PM	B13		S	1		T	D	3A COMP COOLING WATER PUMP FAILED TO START - AUTO	EMER LOAD SEQNCR RELAY CONT MALFUNCTIONED
W	TU3	000780	020574	H	PM	B13		S	1		N	D	3A SAFETY INJ PUMP FAILED TO START	INSUFFICIENT CHARGE ON BRKR CLSG SPRING

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	TU3	010136	050374	H	PM	C11	U		1	N	D		SAFT INJ PMP STOPPD WHEN LOW RUN CURRNT/PRESS SEEN	AIR LEAKAGE INTO PUMP CASING
W	TU3	010135A	050874	B	PT	B06	C		2	T	D		DURNG START TEST A & B AUX FEED FAILD TO START	PACKING TOO TIGHT DEFECTVE PROCEDURES
W	TU3	010135C	050874	B	PT	B09			1	T	T		DURNG START TEST "C"AUX FEED FAILD TO START	FOREIGN MAT IN TURB REG VALVE/GOVERNOR
W	TU3	014880	021976	G	PM	A16	R		1	N	U		WATER LEAKING FROM 3A CHARGNG PMP DURNG NORMAL OPS	CRACK IN CASING BETWEEN VALVCHMBR/STUFF B
W	TU3	016258	101576	G	PM	B21			1	N	T		"3B" CHRG PMP OOS DUE TO DAMAGE TO CONNECTING ROD	INSUFCNT LUBRICTN TO CONN ROD BEARINGS
W	TU3	021010	031578	G	PM	C11	R		1	M	T		"3A" CHRG PMP HAD CRACKD PMP CASING	HI CYCLIC STRESSES
W	TU3	025775	030279	H	PM	C17			1	M	U		3B SI PUMP FOUND TO BE RUBBING	CAUSE UNKNOWN, IMPELLERS MOVED
W	TU3	026562	070179	G	PM	A19			1	N	T		3B CHARGING PUMP REMOVED FROM SERVICE	FAILED PRIMARY AND SECONDARY PACKING
W	TU3	027583	100179	B	PT	B09	R		1	T	T		*A* AFW PUMP FAILED TO START	WATER IN PNEU CONT OF PRESSURE CONTROL VL
W	TU3	027658	110579	B	PT	B20	R		1	T	T		*A* AFW PUMP FAILED TO START	MISALIGN OF CONNECTORS ON PRESS CONT VLV
W	TU3	028094	112879	B	PT	B00	R		1	T	U		*A* AFW PUMP FAILED TO START	CAUSE UNKNOWN
W	TU3	032888	092680	B	PT	C09	R		1	N	T		*A* AUX FEED PUMP FAILED TO DELIVER REQUIRED FLOW	WATER IN PNEUMATIC CONTROLS
W	TU4	000095*	061873	B	PT	B02	U		3	N	D		AUTO START OF AUX FD PMPS DID NOT OCCUR ON SCRAM	FUSES FOR AUTO-START LOGIC CKT NOT INSTLD
W	TU4	018127	041577	I	PM	B09	R		1	N	T		UNITS 3 AND 4 OPERTNG ONLY 2 BORIC AC TRANFR OPRBL	THRUST INBALNCE DUE TO CRYSTAL BLOCKAGE
W	TU4	019700	110977	F	PM	D00			1	N	U		4B CONT SPRAY PMP INBOARD BRNG OVRHEATD	MODEL 3736 4X6-13DV 1450GPM AT 470 FT
W	TU4	025305	012579	I	PM	D02	T		1	N	T		4A BORIC ACID TRANSFER PUMP TRIPPED ON OVERLOAD	INSULATION NOT REINSTALLED, SOLIDIFICATION
W	TU4	027106	081579	G	PM	A19			1	N	T		4A CHARGING PUMP REMOVED FROM SERVICE	SEAL FAILED
W	TU4	027242	082979	I	PM	D11	T		1	N	T		4A BORIC ACID TRANSFER PUMP TRIPPED ON OVERLOAD	SOLIDIFCATION OF BORON IN RECIRC LINE
W	TU4	027241	083079	I	PM	B13	S		1	N	T		4B BORIC ACID TRANSFER PUMP FAILED TO START	MALFUNCTION OF LINE STARTED, DIRTY CONTACT
W	TU4	027239	091179	G	PM	A19	R		1	N	T		4C CHARGING PUMP REMOVED FROM SERVICE	FAILED SEAL
W	TU4	030945	040780	B	PT	C13	S		1	T	T		"A" AUX FEEDWATER PUMP FAILED TO DELIVER REQUIRED	FLOW. CONTROL CIRCUIT OUT OF CALIBRATION
W	YR1	016649	121676	H	PM	A16			1	T	T		#1 HPSI PMP SHAFT HOUSNG SEAL LEAKED	CUT IN GASKET BETWN HOUSNG/STUFFNG BOX
W	YR1	016862	010777	L	PM	A07			1	T	T		PACKING GLND ON #1 LPSI LEAKED EXCESSVELY	PACKN REACHD END OF LIFE REPLACD PACKING
W	YR1	020071	122977	L	PM	D04			1	T	D		#3 LPSI OUTBRD SHFT PACKN GLAND OVERHEATD, PUMP S/D	INSUFCNT CLEARNCE BETWEEN SHFT/PACKN GLND
W	ZI1	000317	091073	G	PM	B13	S		1	N	T		THE 1B CHARGING PUMP WAS INOPERABLE-DID NOT START	FEEDER BRKR BRUSHHOLDER MISSING-VIBRATION

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	ZI1	010081	042774	F	PM	B06	U		1		U	D	1B CONTAINMENT SPRAY PUMP DID NOT START	BRKR RACKED IN TO WRONG POSITION
W	ZI1	010126	043074	B	PM	D04	S		1		N	D	AUX FEED PMP 1B TRIPPD AFTR 30SEC,TRIPPD 2ND TIME	PMP SUCTN LINE MODFIED TO PROVIDE VENTING
W	ZI1	012080	051474	B	PT	B00			1		T	D	AUX FEED PMP 1A FAILD TO START RESET OVERSPD TRIP	OVERSPD TRIP VALVE FOUND TO BE TRIPPD
W	ZI1	010281	060674	B	PT	D09	R		1		N	T	1A AUX FEEu OVERSPD VALV TRIPPD RESET THEN STARTED	WATER HAMMER BROKE TURBIN EXHAUST HANGER
W	ZI1	010718	071174	B	PT	B02	U		1		U	D	AUX FD PUMP 1A FAILED TO START FROM CONT RM	AUX FD L.O. PUMP PWR SUPPLY BKR WAS OPEN
W	ZI1	010914	091974	B	PM	B14			1		N	U	1C AUX FEED DOES NOT START PUMP INTERNALS DAMAGED	CAUSE UNKNOWN UNDER INVESTIGATION
W	ZI1	013217	082575	F	PD	B13	S		1		T	T	CONTAINMENT SPRAY DIESEL FAILED TO START	DIESEL STARTING BATTERIES FAILED
W	ZI1	014269	030576	B	PT	B09	R		1		N	D	1A AUX FEED PUMP FAILED TO START	TURBINE WAS WATER BOUND
W	ZI1	015367A	080876	B	PT	B00			1		N	U	1A AUX FEED TRIPPD AFTR STRTD DUE TO OVERSPD TRIP	PROBABLY STICKY GOVERNOR VALVE
W	ZI1	0153678	080876	B	PM	C09			1		N	T	1C AUX FEED FAILD TO DEVELP FULL DISHRG HEAD	PLUGGED SUCTION STRAINER
W	ZI1	020112	120377	B	PT	B13	T		1		T	D	1A AUX FD PUMP WOULD NOT START	STM FLO CONT VLV SOL STUCK IN ENERGZD POS
W	ZI1	020105	120877	B	PT	B13	T		1		T	D	1A AUX FD PUMP WOULD NOT START	STM FLO CONT VLV SOL STUCK IN ENERGZD POS
W	ZI1	023442	122678	F	PD	D18			1		T	T	CONTAINMENT SPRAY PUMP 1C DEVELOPED HOSE RUPTURE	COOLING SYS HOSE ON DIESEL BROKE
W	ZI1	027284	092579	B	PM	B00			1		N	U	FOLLOWING RX TRIP 1C AFW PUMP STARTED THEN TRIPPED	RESTARTED MANUALLY,CAUSE NOT STATED
W	ZI2	0008938	021174	B	PM	D11	B		1		U	D	AUX FD PUMP 2B HAD PREVIOUSLY FAILED	APPARENTLY DAMAGED FROM AIR BINDING
W	ZI2	000814	021574	B	PT	B11	V		1		T	D	2A AUX FEED PUMP STARTED,BUT TRIPPED ON OVERSPEED	AIR WAS ASPIRATED INTO THE PUMP
W	ZI2	000893A	021574	B	PM	C11	V		1		N	D	2C AUX FD PUMP STARTED - DISCH PRESS DID NOT RISE	AIR BINDING OF PUMP IMPELLER
W	ZI2	000881	031274	B	PM	B13	S		1		U	D	2B AUX FD PMP FAILED TO START	OIL PRESS START INTLK SW WOULD NOT CLOSE
W	ZI2	010709	071274	F	PD	C02	S		1		T	D	CONT SPRY INJ PMP 2C OPERATD 10% BELOW NORMAL HEAD	MAN CONT VALV NOT PROPERLY LOCKED
W	ZI2	016051*	091976	K	PM	D01	U		2		N	D	TWO RCPS WERE INADVERTENTLY TRIPPED OFF-LINE	PERSONNEL MADE SWITCHING ERROR
W	ZI2	019997	120777	B	PM	B00			1		N	U	2B AUX FEED PMP FAILD TO START	NO APPARENT CAUSE FOR FAILURE
W	ZI2	022996	110878	F	PD	D18			1		T	T	CONTAINMENT SPRY PUMP 2C DEVELOPED HOSE RUPTURE	COOLING SYS HOSE ON DIESEL BROKE
G	BF1	000301	090473	H	PT	B13	T		1		U	D	STM SUP VLV TO HPCI TURBINE,FCV-73-16,FAILED TO OP	LIMITORQUE DRIVE MOTOR-DAMAGED GEARS
G	BF1	000368	091073	H	PT	R13	T		1		T	D	HPCI FAILED TO REACH RATED SPEED & FLO ON QK START	FLOW CONTROLLER MALFN-BAD CONNECTOR
G	BF1	000518A	111073	H	PT	U13	N		1		N	U	HPCI INOPERABLE UNTIL MANUALLY RESET	TRIP LOGIC IMPROP DESIGNED FOR LOSP

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	BF1	0005188	111073	Q	PT	U13		N	1		N	U	RCIC INOPERABLE UNTIL MANUALLY RESET	TRIP LOGIC IMPROP DESIGNED FOR LOSP
G	BF1	000521	111573	Q	PT	B13		S	1		T	D	RCIC SYS FAILED TO OPER WHEN MANUALLY INITIATED	STEAM SUPPLY VLV WOULD NOT OPEN
G	BF1	000522	111573	H	PT	B00		S	1		N	U	HPCI ISOLATED AND TRIPPED ON MANUAL INITIATION	NO APPARENT CAUSE
G	BF1	000655	122573	H	PT	C13		T	1		T	T	HPCI TURBINE FAILED TO REACH RATED SPEED & FLOW	GOVERNOR UNABLE TO PROPERLY SIGNAL CONTRL
G	BF1	000713	011774	U	PM	A19			1		T	T	1B STBY LIQUID CONT PUMP FAILED SURVEILLANCE TEST	PACKING ON 1 OF 3 PUMP PLUNGERS FAILED
G	BF1	000872	012674	H	PT	C13		T	1		T	D	HPCI FLOW & TURBINE SPEED UNSTABLE	DEFECTVE PARTS IN EGM CONTROL BOX
G	BF1	010018	031274	H	PT	C13		T	1		T	T	HPCI TURBINE FAILED TO REACH RATED SPEED AND FLOW	EGM BOX FAILED DUE TO DEFCTV TRANSISTOR
G	BF1	000978	041374	H	PT	C13		T	1		U	T	HPCI FAILED TO REACH RATED FLOW IN REQUIRED TIME	TWO DFCTV XSISTORS IN GOV EGM CONTROL BOX
G	BF1	010122	050574	H	PT	B00		R	1		N	U	HPCI SYSTEM ATTEMPTED TO START BUT TRIPPED	UNDETERMINED
G	BF1	010171*	051374	R	PM	D02		U	2		T	D	RHR PMPS TRIPPD DUE TO ISOLATION VALVES CLOSING	FAULTY RELAYS FOR FCV74-47 AND FCV74-77
G	BF1	010294	0609.4	H	PT	B13		R	1		T	D	HPCI REQD SEVERAL MANUAL START ATTEMPTS FOR OPERTN	OIL RELAY VALVE DID NOT OPEN FULLY
G	BF1	010377*	061874	D	PM	B13		U	2		T	D	1B & 1C COR SPRA DIDNT START DURIN SURVLLNC TESTIN	BENT CONTACT ARM ON RELAY (MANUAL START)
G	BF1	010422	062174	H	PT	B13		R	1		U	D	HPCI TURBINE FAILED TO START MANUALLY	TURB STOP VLV PILOT PISTON WAS MALFUNCTNG
G	BF1	010533	082074	Q	PT	B04		T	1		N	D	RCIC FAILED TO START AFTER A REACTOR SCRAM	CONTROL COMPONENTS OUT OF CAL-WRONG LOCTN
G	BF1	010793	091874	H	PT	B13		T	1		N	D	HPCI FAILD TO START DURIN SURVLLNCE AT 95% POWER	CONTACTS IN AUX OIL PMP CIRCUIT HUNG UP
G	BF1	010938	111574	Q	PT	B20			1		T	T	RCIC TRIPPED ON OVERSPEED DURING AUTO-INITIATION	REMOTE SERVO OUT OF ALIGNMENT W GOV LEVER
G	BF1	015929A	092176	H	PT	D18		T	1		T	T	HPCI TRIPPED DURING TESTING	LEAKING STEAM DISCHARGE LINE RUPTURE DISK
G	BF1	0159298	092176	Q	PT	B13		T	1		T	T	RCIC FAILED REQUIRED SURVEILLANCE TEST	GOVERNOR EG-R MALFUNCTIONED
G	BF1	018124	050277	Q	PT	C13		T	1		T	T	RCIC SYSTEM FAILED TO REACH RATED FLOW AND PRESS	IMPROPER SPEED REF VLTG TO EG-M CONT BCX
G	BF1	018126	050977	H	PT	B13		T	1		T	D	HPCI TURB STM SUPPLY VLV,FCV-73-16, FAILED TO OPEN	LIMITORQUE ACTUATOR,MOD SMB-2,BROKN TEETH
G	BF1	018122	051277	H	PT	B13		T	1		T	D	HPCI AUX OIL PUMP FAILD TO START	DEFECTIVE PRESS. SWITCH
G	BF1	019540	080177	Q	PT	C13		T	1		T	T	RCIC TURB DID NOT PRODUCE RATED FLOW IN REQD TIME	RAMP GEN AND SIGNAL CONVERTER OUT OF ADJ
G	BF1	018691	080877	H	PT	D13		T	1		T	T	HPCI TURBINE SPEED CONTROLLER WOULD NOT CONT TURB	POWER SUPPLY TO GOV FAILED-RESISTOR FAILD
G	BF1	027159*	092679	K	PM	D03		V	2		N	D	A AND B RECIRCULATION PUMPS TRIPPED	TROUBLESHOOTING WRONG TERMINAL STOP
G	BF1	027316	101079	H	PT	D04		T	1		T	D	HPCI TURBINE TRIPPED DUE TO RUPTURE DISK RUPTURE	REPLACING WITH IMPROVED RUPTURE DISK

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	BF1	027682*	112679	K	PM	D03		V		2	N	D	BOTH RECIRC MG SETS SHUTDOWN DURING NORMAL OP.	PERSONNEL TESTING WRONG RELAYS
G	BF1	027834	120379	H	PT	B13				1	T	T	HPCI STOP VALVE FAILED TO REMAIN OPEN	SPRING IN TRIP MECHANISM NOT COMPRESSED
G	BF1	030306	012780	H	PT	C11		T		1	U	D	HPCI PUMP TURBINE HAD CRACK ON COUP BEAR SUPP PED.	BELIEVED TO BE CAUSED BY A WATER HAMMER
G	BF1	030887	040280	Q	PT	D18		T		1	T	D	RCIC TRIPPED DUE TO A HIGH RUPTURE DISC PRESSURE	TEFLON SHEET PORTION OF DISC FAILED
G	BF1	030977	040780	H	PT	D18		T		1	T	D	HPCI PUMP TRIPPED DUE TO FAILED EXHUST RUP. DISC	TEFLON SHEET PORTION OF DISC FAILED
G	BF1	031403	060280	H	PT	D13		R		1	T	T	HPCI PUMP FAILED DUE TO INADVERTANT TRIPPING	WORN OVERSPEED TRIP PISTON
G	BF2	010491	081174	H	PT	B02		U		1	T	T	HPCI ISOLATION OCCURED DURING MANUAL HPCI START	EXHST RUPTURE DISK FLO-SOL VLV WIRED WRNG
G	BF2	010493	082374	Q	PT	C13		T		1	U	T	RCIC FAILED TO REACH RATED FLOW	TURBINE TACHOMETER CIRCUIT FAILED
G	BF2	010815	092474	H	PT	B04		T		1	N	D	HPCI SYSTEM INOPERABLE DUE TO EXHAUST LINE FLOODED	SUMP FLOODING CAUSD HOTWELL PUMP FAILURE
G	BF2	010816	100774	H	PT	B04		T		1	N	D	FLOODED SYS. DUE TO LEAKING GLAND SEAL COND. GASKT	FLOODED TURB. SUMP & HOTWELL PUMP
G	BF2	010996	110474	H	PT	B04		T		1	N	D	HPCI INOPERABLE DUE TO FLOODED GLAND STEAM CONDEN.	RUPTURED GASKETS ON CONDENSER
G	BF2	011097	120374	H	PT	B04		T		1	N	D	HPCI AUTO-ISOLATED AFTER AUTO-ACTUATION	NO PROVISION FOR EXHAUST LINE DRAINAGE
G	BF2	012083	010775	Q	PT	B13		T		1	T	T	RCIC SYSTEM FAILED TO OPERATE DURING A TEST	RESISTOR FAILED IN PWR SUP TO EGM CONTRLR
G	BF2	012082	011675	Q	PT	D13		R		1	N	T	RCIC TURBINE TRIPPED DURING NORMAL OPERATION	MECH OVRSPD EMERG TARGET NUT HAD ROTATED
G	BF2	015936	090876	Q	PT	C13		T		1	T	T	RCIC TURBINE GOV SPEED CONTROL FAILED TO RESPOND	OPEN RESISTOR IN GOV PWR SUP ASSEMBLY
G	BF2	016807	111676	H	PT	B13		S		1	T	D	HPCI TURBINE STEAM SU[illegible] VLV,FCV-73-16,FAILED TO OPN	LIMITORQUE SMB-2 TORQUE SW GEAR PIN BROKE
G	BF2	021782	062778	H	PT	D03		C		1	T	D	DAMAGE SUBSTAINED TO HPCI PUMP AND REDUCTION GEARS	VALVE IN LUBE OIL LINE WAS NOT OPENED
G	BF2	022085	080578	U	PM	C07				1	T	T	2B STANDBY LIQUID CONTROL PUMP FAILED TO REACH CAP	NORMAL WEAR TO VALVE,SEATING SURFACES
G	BF2	030311	020380	K	PM	D03		T		1	T	D	2A REACTOR RECIRC PUMP ACCIDENTLY TRIPPED	MISINTERPRETED PUMP LABEL ON TRIP BREAKER
G	BF2	030312	020380	K	PM	D13		S		1	N	D	2B RECIRC PUMP TRIPPED	SPURIOUS SIGNAL,MG SET GEN STATOR TEMP
G	BF2	030360	020680	K	PM	D03		T		1	N	D	2B RECIRC PUMP TRIPPED	WRONG RELAY OPERATED
G	BF2	030417	021680	H	PT	C11		S		1	M	D	HPCI PUMP TUR HAD CRACK ON COUP BEAR SUPPORT PED.	BELIEVED TO BE CAUSED BY WATER HAMMER
G	BF2	030637	031090	H	PT	D18		T		1	T	D	HPCI PUMP TRIPPED DUE TO FAILED EXH RUPTURE DISC	TEFLON SHEET PORTION OF DISC FAILED
G	BF2	031547	060780	K	PM	D11		T		1	N	T	2A RECIRC PUMP TRIPPED ON HIGH STATOR TEMP ON MG	LOOSE CONNECTION DUE TO VIBRATION
G	BF2	032259	081280	H	PT	D18		T		1	T	D	HPCI PUMP TRIPPED DUE TO FAILED EXH RUPTURE DISC	TEFLON SHEET PORTION OF DISC FAILED

ALL FAULTS CONSIDERED IN PUMPS

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G	BF3	016055	082476	H	PT	B18	S		1	T	D	RUPTURE DISK ON STM DISCH LINE FAILED ON HPCI S/U	CHK VLV IN EXHST LINE SLAMMING
G	BF3	015937	082676	H	PT	B13	T		1	T	T	HPCI TURBINE CYCLED ON START UP	GROUNDED CONNECTION ON GOV EGM BOX
G	BF3	016056	092176	H	PT	C18	S		1	T	T	HPCI SHAFT OIL PMP PESS.LOW CAUSN ERRATIC TURBINE	LEAKING UNION ON SUCTION OF OIL PUMP
G	BF3	016057	092376	L	PM	B13	S		1	T	U	RHR PMP 3C FAILD TO START ON NORMAL POWER	OPEN CABLE IN RHR LOGIC
G	BF3	016059	100176	Q	PT	C02	S		1	T	D	RCIC CONTROLLER FAILED TO CONTROL SPEED	BROKEN WIRE IN GOV SPEED SENSING CIRCUIT
G	BF3	016268	103076	K	PM	D06	S		1	N	T	3B RECIRC TRIPPD DUE TO BURND COLLECTR RING ON MG	CARBON BRUSH WORE TOO SHORT
G	BF3	018637	070577	H	PT	B13	S		1	T	D	HPCI TURBINE STM SUP VLV,FCV-73-16,FAILED TO OPEN	TORQUE SW GEAR ASSY,SMB-2,REPLACED
G	BF3	018892	083077	H	PT	C13	T		1	T	T	HPCI TURBINE SPEED CONTROLLER WOULD NOT CONT TURB	OPEN RESISTOR IN GOVERNOR POWER SUPPLY
G	BF3	021839	070678	H	PT	D13	T		1	T	D	HPCI PUMP TRIPPED DURING SURVEILLANCE TEST	FAILED RESISTOR IN POWER SUPPLY TO GOVEN.
G	BF3	023185	112478	Q	PT	D13			1	T	T	RCIC PUMP TRIPPED ON OVERSPEED	OIL LEAK ON ELEC-GOVENOR-REGULATOR
G	BF3	031576	060980	Q	PT	D13			1	T	T	RCIC TURBINE TRIPPED ON OVERSPEED	VOLTAGE SUPPRESSOR IN EGM BOX FAILED
G	BF3	032025	071480	L	PM	D13	S		1	T	D	3D RHR PUMP TRIPPED ON INSTANTANEOUS OVERCURRENT	POSSIBLE INCORRECT SETPOINT OF RELAY
G	BF3	032542	090180	K	PM	D00			1	N	U	'A' RECIRC PUMP TRIPPED	CAUSE UNKNOWN
G	BF1	019025	082977	F	PD	B13	S		1	T	D	DIESEL FIRE PUMP FAILED TO START DURING REFUELING	2 BATTRY CABLES LOOSE; B BATTRY WAS DISCH
G	BR1	016861	112176	H	PT	B13	S		1	T	T	HPCI STM SUPPLY VLV,E41-F001, WOULD NOT OPEN	BRUSHES IN VALVE MOTOR WERE STICKING
G	BR1	016858	120376	Q	PT	B13	S		1	T	T	RCIC STM ISOLATION VLV,E51-F007, FAILED TO OPEN	LOOSE WIRE ON VLV MOTOR OPEN CONTACTOR
G	BR1	016856	010577	R	PM	B00			1	T	U	1A RHR FAILD TO START--MANUAL START FAILD ALSO	NO CAUSE DETERMINED
G	BR1	0181674	060177	R	PM	B13	S		1	T	D	1A RHR DID NOT START ON AUTO-SIGNAL	STICKY CONTACTOR ON CONTROL SWITCH
G	BR1	0181678	061877	R	PM	D01	S		1	T	D	2A RHR TRIPPD DUE TO OPERATOR HITTING SWITCH	ACCIDENTAL BUMPING OF CONTROL ROOM SWITCH
G	BR1	019272	093077	Q	PT	B00	R		1	T	U	RCIC TURBINE TRIPPED ON HI EXHST PRESS DURING S/U	NO CAUSE GIVEN
G	BR1	019493	102577	K	PM	D13	S		1	N	D	1A RECIRC TRIPPD DUE TO RECIRC MG SET TRIPPING	LO LUBE OIL PRESS. DUE TO CONTROL VALVE
G	BR1	019677	110577	L	PM	B02	S		1	T	T	RHR 1A DID NOT START; COVER LOOSE & CONTACTS CORRO	CORRODED DUE TO WATER LEAKS
G	BR1	019679	110577	H	PT	D01	S		1	T	D	HPCI TURBINE TRIP DUE OIL PMP TRIP;SHORTED MOTOR	HI WATER IN HPCI ROOM DUE TO PMPING ROOMS
G	BR1	019842A	111077	Q	PT	B00	R		1	T	U	RCIC TURBINE TRIPPED DURING MANUAL START UP	NO CAUSE FOUND
G	BR1	019842B	111177	Q	PT	B00	R		1	T	U	RCIC TURBINE TRIPPED ON HI EXST DURING MAN START	NO CAUSE FOUND

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	BR1	020209	122977	K	PM	D02		S	1	N	D	RECIRC PMP 1A TRIPPD DUE TO MG SET TRIPPING	STRING ON MG BKR GOT CAUGHT AND TRIPPED
G	BR1	020614	021378	Q	PT	B00		R	1	N	U	RCIC TURBINE TRIPPED ON OVERSPEED AFTER RX SCRAM	NO CAUSE DETERMINED FOR OVERSPEED
G	BR1	021090	041278	H	PT	C01			1	T	T	TURBINE CONT. VALVE WOULD NOT OPERATE DUE TO CORRD	EXCESSVE WTR IN ROOM(OCT.77) WAS CAUSE
G	BR1	021253	042178	Q	PT	D10		S	1	T	T	RCIC TRIPPD DUE TO FALSE MECH. OVERSPEED INDICATIN	EGR ACTUATOR CORRODED;LEAKY VALVES
G	BR1	022699	101478	Q	PT	B02		S	1	T	D	RCIC TURBINE STOP VALVE WOULD NOT RESET AFTER TRI*	EXCESSIVE PAINT AND DIRT ON TRIP LEVER
G	BR1	023061	111478	H	PT	C09			1	T	T	HPCI EGR FAILED TO OPERATE PROPERLY	WATER IN HYDRAULIC FLUID CAUSED CORROSION
G	BR1	025090	010479	H	PT	C13			1	T	T	HPCI TURBINE FAILED RESPONSE TEST	GOVENOR ASSEMBLY OUT OF ADJUSTMENT
G	BR1	025091	010479	K	PM	D20		S	1	N	T	1A RECIRC PUMP TRIPPED DUE TO LOW LUBE OIL ON MG	MISSING LOCK NUT ON LO ADJ CAUSED DRIFT
G	BR1	025041	010979	L	PM	B13		S	1	T	D	RHR PUMP "D" WOULD NOT START	INTERNAL PWOBLEMS IN CIRCUIT BKR
G	BR1	027037	091679	H	PT	U13		S	1	N	T	HPCI TURBINE NOTICED TO BE TRIPPED	SUCTION PRESSURE SWITCH FOUND OUT OF CAL
G	BR1	027232	092679	Q	PT	D02			1	N	D	RCIC TURBINE TRIPPED	MEN WORKING ABOVE TRIP MECHANISM
G	BR1	030195	012180	H	PT	D13		S	1	T	T	HPCI AUX LUBE OIL PUMP WOULD NOT RUN IN AUTO	LOOSE WIRE ON RTGB CONTROL SWITCH
G	BR1	030408	021480	L	PM	D00			1	T	U	1D RHR PUMP TRIPPED IN TORUS COOLING MODE	CAUSE UNKNOWN,BKR RESET AND PUMP STARTED
G	BR1	0307734	032480	H	PT	B13		R	1	N	T	HPCI PUMP TRIPPED ON OVERSPEED WHILE STARTING	STROKE TIME FOR STOP VALVE WAS TO FAST
G	BR1	0307738	040280	H	PT	B13		R	1	T	T	HPCI PUMP TRIPPED ON OVERSPEED WHILE STARTING	STROKE TIME FOR STOP VALVE WAS TO FAST
G	BR1	031149	050180	K	PM	D13		S	1	N	T	1A RECIRC PUMP TRIPPED ON MG SET LOW LUBE OIL PRES	PRESS SW SET TOO HI WITH ERRATIC PRESSURE
G	BR2	013325	041375	Q	PT	D18		T	1	N	D	RCIC TURBINE TRIPPED DUE TO HIGH EXHAUST PRESSURE	EXHAUST LINE CHECK VALVE STUCK SHUT
G	BR2	013343	041475	H	PT	B02		U	1	T	D	HPCI TURBINE STOP VALVE V8 FAILED TO OPEN FULLY	PERSONNEL ERROR-NEEDLE VLVS IMPRPR ADJST
G	BR2	013379	041475	H	PT	B13		S	1	T	T	HPCI TURBINE SUPPLY VALVE F001 FAILED TO OPEN	VALVE MOTOR WINDINGS FAILED
G	BR2	013619	080475	K	PM	A04		R	1	N	D	AFTER SCRAM FROM PWR, 2B RX RECIRC PUMP LEAKED	HOT COOLANT REACHED SEALS,CRACKED SL FACE
G	BR2	013560	082475	K	PM	A04		R	1	N	D	AFTER SCRAM FROM PWR, 2B RX RECIRC PUMP LEAKED	HOT COOLANT REACHED SEALS,CRACKED SL FACE
G	BR2	013626	090275	H	PT	B13		S	1	T	D	HPCI STEAM ISOLATION VALVE F003 FAILED TO OPERATE	AUXILIARY RELAY PLUNGER BROKE
G	BR2	013620	090575	K	PM	A04		R	1	N	D	AFTER SCRAM FROM PWR, 2B RX RECIRC PUMP LEAKED	HOT COOLANT REACHED SEALS,CRACKED SL FACE
G	BR2	013514	100175	Q	PT	B13		R	1	T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013515	100375	Q	PT	B13		R	1	T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	BR2	013516	100475	Q	PT	B13	R	1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013517	100975	Q	PT	B13	R	1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013689	102775	Q	PT	B14	T	1		U	D	RCIC TURBINE TRIPPED BECAUSE OF HIGH EXHAUST PRESS	CHK VLV F040 JAMMED PARTIALLY CLOSED
G	BR2	013800	110375	Q	PT	B13	R	1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013702	111075	Q	PT	B13	R	1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013798	111475	K	PM	D13	S	1		N	U	56% PWR R/X RECIRC 2A TRIPPD--2A MG SET INOPERBLE	NO PROBLEM FOUND WITH MG SET
G	BR2	013799	111475	Q	PT	B13	R	1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	DRAIN DOWN OF CONTROL OIL FROM CONT VALVE
G	BR2	013816	111875	Q	PT	B13	S	1		T	T	RCIC TURBINE TRIPPED ON OVERSPEED DURING START	BURNED OUT XSISTORS IN GOV VLV CONTROLLER
G	BR2	014646	020476	Q	PT	B18	T	1		U	D	RCIC TURBINE TRIPPED ON HIGH EXHAUST PRESSURE	DISCHARGE CHK VLV,F040,DISC BLOCKING FLOW
G	BR2	014947*	052776	K	PM	D01	N	2		T	D	RECIRC PUMPS TRIPPD ON LOW L.O. PRESS	OPERATOR DID NOT FOLLOW EMERGNCY PROCEDRE
G	BR2	014947A	052776	K	PM	D19	R	1		N	D	28 RECIRC SEALS FAILD FOLLOWING RX SCRAM 30% PWR	NOT STATED AS TO REASON
G	BR2	014946	053076	K	PM	D13	S	1		N	T	RECIRC LOOP INOP. DUE TO 2A MG SET TRIP ON OVERCRN	OVERCURRENT RELAY "50B" FAULTY
G	BR2	016260	110276	Q	PT	B02	U	1		N	D	RCIC TURBINE TRIPPD ON HI EXHAUST PRESS	EXHAUST STOP-CHECK VLV NOT OPENED
G	BR2	016397	110976	K	PM	A04	R	1		N	D	RX IN RUN MODE, ALARMS INDICATE 2B RECIRC PMP PROB	PUMP SEALS FAILED DUE TO THERMAL SHOCK
G	BR2	017186	020777	D	PM	B13	S	1		T	U	CORE SPRAY 2B FAILD TO START--BKR CHARGIN SPRING	CHARG. SPRING MANUALLY CHARGED,BKR CLOSED
G	BR2	017327	022377	Q	PT	B13	S	1		N	T	RCIC TURBINE STEAM INLET VALVE WOULD NOT OPEN	VALVE OPERATOR FOR F045 WAS BURNED UP
G	BR2	017535	040577	H	PT	B11	T	1		N	T	HPCI AUTO STARTED BUT THEN TRIPPED ON HI DELTA T	RX BLDG HEAT WAS OFF-THEREFORE HI DELTA T
G	BR2	018134	050777	Q	PT	B01	U	1		N	D	RCIC TURB. OVERSPED AFTR MANUAL START FOLLWN SCRAM	OPERATOR DIDN'T CHECK MAN. SPEED SETTING
G	BR2	018673	061477	H	PT	B11	T	1		N	T	HPCI TRIPPED ON HIGH DIFFERENTIAL TEMPERATURE ISOL	RX BLDG VENTLTN WAS ISOL-HI HPCI RM TEMP
G	BR2	018676	062277	L	PM	B01	U	1		T	D	RHR 2A CHARGN MOTOR SWITCH IN OFF POSITION	PERSONEL LEFT SWITCH IN OFF POSITION
G	BR2	019016	090477	H	PT	B13		1		N	T	HPCI FAILED TO INJECT WATER ON RX SCRAM	LOOSE FITTING IN CONT OIL LINE TO SERVO
G	BR2	020206	122777	H	PT	C13	S	1		T	T	HPCI TURBINE SPEED COULD NOT BE CONTROLLED	DEFECTIVE EGM UNIT-GROUND IN EGR ACT COIL
G	BR2	022453	092478	Q	PT	B00		1		T	U	RCIC TURBINE TRIP AND THROTTLE VALVE TRIPPED	TRIP THROTTLE COULD NOT BE RESET,UNKNOWN
G	BR2	025377	030179	H	PT	C13		1		T	T	HPCI PUMP HAD SEVERE OSCILLATIONS WHEN ACCELERATIN	SET SCREWS ON SPUR GEAR ON REF SPEED LOOS
G	BR2	025639*	040479	R	PM	B13	U	2		T	T	RHR PUMPS 2B AND 2D WOULD NOT START FROM RTGB	POOR CONNECTIONS ON FUSES & FUSE BOX

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G	BR2	026037	051879	H	PT	D13			1	T	T	HPCI PUMP TRIPPED ON OVERSPEED TOO SOON	ADJUSTING SCREW FOUND 5 TURNS OUT OF PCS.
G	BR2	027769A	120679	K	PM	D13	T		1	N	D	2B RECIRC PUMP TRIPPED	BLOWN FUSES DUE TO SHORT BRUSHES
G	BR2	027769B	121379	K	PM	D13	T		1	N	D	2B RECIRC PUMP TRIPPED	BLOWN FUSES DUE TO SHORT BRUSHES
G	BR2	030194A	012380	K	PM	D13	T		1	N	D	2B RECIRCULATION PUMP TRIPPED	FUSES BLOWN IN VOLT FEEDBACK CIRCUITRY
G	BR2	0301949	021080	K	PM	D13	T		1	N	D	2B RECIRCULATION PUMP TRIPPED	FUSES BLOWN IN VOLT FEEDBACK CIRCUITRY
G	BR2	030526	022980	K	PM	D06	S		1	T	D	2A REACTOR RECIRC PUMP TRIPPED	WIRE CONNECTED FOR TEST, CAUSED TRIP
G	BR2	032454A	090780	Q	PT	D01	U		1	T	D	RCIC TURBINE TRIPPED ON HIGH EXHUST PRESSURE	INCORRECT VALVE LINE-UP
G	BR2	0324548	090780	H	PT	U01	U		1	T	D	HPCI STOP-CHECK ALSO FOUND SHUT	PERSONNEL DIDNT VERIFY POSITN AFTER MAINT
G	C01	010207	030874	H	PT	C13	S		1	T	U	TURBINE SPEED CONTROL PROBLEMS DURIN PUMP OPER TES	DIODE VR1 IN SPEED REF. CKT. OF AMPLIFIER
G	C01	010296	053074	Q	PT	B13	S		1	T	T	RCIC TRIPPED ON OVERSPEED DURING STARTUP TEST	FLOW CONTROLLER DRIFTED UPWARD 4 MA
G	C01	011261	121374	J	PM	D18	R		1	N	T	1B CCW PMP MOTOR EXPERIENCD INSULATION FAULT-STATR	STATOR WINDNGS MIN. CLEARANCE;TEND TO SAG
G	C01	012814	051275	Q	PT	C13	S		1	T	D	RCIC FLOW WAS 375 VS 388 GPM FOR CORRSPNDG PRESSUR	FLOW INSTRUMENTS CALIBRATION WAS TOO LOW
G	C01	013063	070275	J	PM	D18	R		1	N	T	1A CCW INSULATION BREAK IN STATOR	COOL. FINS HIT WINDINGS (SAGGING)
G	C01	014304	012276	Q	PT	C04	S		1	T	T	RCIC TURB. WOULD NOT RESPOND TO CONTROL INPUT	R-14 & R-15 IN PCB. ASSY FAILD FROM HEAT
G	C01	014302	020676	K	PM	D00			1	N	U	RECIRC PMP "B" TRIPPD	UNKNOWN
G	C01	014360	022776	K	PM	D04	S		1	N	T	RR PUMP "B" DRIVE MOTOR TRIPPD TWICE --TEMP.SWITCH	SWITCH TRIPPD DUE TO VIBRATION;TYPE DA438
G	C01	015715	081676	J	PM	D21	R		1	N	T	REC PUMP "A" MOTOR MAKING NOISE BEARINGS FAILED	SER.NO.P4296075, 75HP.,480VAC
G	C01	016604	111276	K	PM	D13	S		1	N	T	"B" RECIRC PMP TRIPPD DUE TO FALSE OP.OF NBI-LIS	MOISTURE IN MODEL 4418C SWITCH;LEAKY VLVE
G	C01	017068	011077	J	PM	D21	R		1	N	T	REC PUM MOTOR "A" NOISY BEARINGS RUNNING ROUGH	BEARINGS REPLACED
G	C01	018898	083177	H	PT	C13	S		1	N	T	HPCI TURB STARTED BUT DID NOT ACCEL OR INJECT	GOVERNOR EG-R ACTUATOR FAILED TO OPERATE
G	C01	019289	083177	Q	PT	C13	S		1	N	T	RCIC INITIATED ON SCRAM BUT DID NOT RAMP UP SPEED	VITAL PWR FUSE BLOWN AND CONTACTOR DOS
G	C01	020049A	112177	U	PM	A05			1	T	D	"B"SBLC PUMP STUFFING BX GLAND FOLLOWER BLEW OUT	MOVEMENT OF INSUFF CONTAINED GLAND FLWR
G	C01	0200498	112177	U	PM	C05			1	T	D	"B"SBLC PUMP FAILED TO MEET REQD FLOW AT PRESSURE	3 IN LIEU OF 5 PKG RINGS INSTLLD BY MFGR
G	C01	020804	011178	H	PT	002			1	T	D	SIGNIF AMT OF WTR DISCOVD BLWING FRM HPCI CASE FLG	CASE NOT TORQD CORRECTLY BY MAINT PRSNL
G	C01	020805	020778	H	PT	D02	S		1	T	D	TURBINE SPEED 74000RPM LED TO HPCI STEAM LINE TSO	DPIS 76677 READING HI;SENSING LINE BACKFL

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G	CO1	021061	031178	Q	PT	C13	S		1		T	T	RCIC TURBINE FAILED TO RESPOND PROPERLY	RAMP GENERATOR MISALIGNED DUE TO DRIFT
G	CO1	026930	080979	H	PT	B13			1		N	T	HPCI PUMP FAILED TO START ON AUTO START SIGNAL	TURBINE STOP VALVE OPERATOR MALFUNCTIONED
G	CO1	027345	091279	K	PM	A19			1		N	T	LEAK DEVELOPED FROM *B* RECIRC SEAL	SEAL REPLACED
G	CO1	027957	122379	L	PM	B13	S		1		N	D	RHR PUMP *1D* WOULD NOT OPERATE	BREAKER FAILURE
G	CO1	030788	031080	U	PM	C07			1		T	T	SLC PUMP 1B WOULD NOT PUMP REQUIRED FLOW RATE	LEAKING INTERNAL SUCTION AND DISCH VALVES
G	CO1	030855	031280	Q	PT	C09			1		M	D	RCIC TURBINE BLADING FOUND DAMAGED	IMPINGMENT OF FOREIGN OBJECT ON THE WHEEL
G	DA1	010219	060474	Q	PT	B06	U		1		T	D	RCIC FAILED TO START AUTOMATICALLY	GOV CONT CKT SET HIGHER THAN OVRSPD TRIP
G	DA1	010424A	062274	H	PT	B13	S		1		T	U	HPCI FAILED TO INJECT	HPCI STOP VALVE FAILED TO OPEN
G	DA1	0104248	062374	H	PT	B04			1		U	D	HPCI FAILED TO INJECT WITHIN REQUIRED TIME	PISTON IN MECH OVRSPD TRIP WAS UNDERSIZED
G	DA1	010580	081474	K	PM	A19			1		U	T	UNIDENTIFIED LKG TO DRYWELL EXCEEDED TS LMT, 5 GPM	LKG FRM RECIRC PMP B SEALS, CORRSN PRDCTS
G	DA1	012797	042375	R	PM	B13	S		1		T	D	RHR PMP 229B FAILD TO START	LOGIC RELAY E11-K70B DID NOT TRIP AS REQ.
G	DA1	012848	061375	D	PM	B09	S		1		N	D	CORE SPRAY PMP 211A DID NOT START ON SIGNAL	DIRTY AUX CONTACTS ON 4KV CKT BKR
G	DA1	013576	102275	H	PT	C13	S		1		T	T	HPCI TURBINE WOULD NOT RESPOND TO SPEED CHANGE SIG	HPCI SPEED CONTROLLER RELAY MALFUNCTIONED
G	DA1	016588	122076	H	PT	B06	U		1		T	D	HPCI TURBINE TRIPPED ON FAST START WITH HI FLO IND	HI FLOW POIS SETPOINTS WERE INCORRECT
G	DA1	019127	092177	H	PT	C06	U		1		T	D	HPCI WOULD NOT DEVELOP SUFFCNT RPM	EXCESSIVE OPENING OF L.O. THROTLE VALVES
G	DA1	019705	102877	K	PM	C13	S		1		N	T	"A" RECIRC HAD SLIGHT DECREAS IN FLOW DUE TO M-G	VOLT. REG. FOR MG HAD OPEN IN TRANSFORMR
G	DA1	019968	122077	H	PT	C02	Y		1		T	D	HPCI DISCH FLOW RATE DID NOT REACH REQD FLOW	IMPROPER ADJUSTMENT OF THTL SCREWS
G	DA1	020178	122777	H	PT	C07	T		1		T	D	HPCI SYS DID NOT REACH REQD FLOW RATE OF 3000 GPM	WEAR TO TURBINE SHAFT DRIVEN OIL PUMP
G	DA1	021565	051978	H	PT	C13			1		T	T	HPCI PUMP DID NOT REACH RATED CAPACITY	THROTTLE ADJ SCREWS FOUND OUT OF ADJUST.
G	DA1	030456	030480	H	PT	C04			1		M	D	HPCI BOOSTER PUMP SLPIT RING FOUND IN MAIN HPCI P.	WRONG SET SREWS USED IN BOOSTER PUMP
G	DA1	031167	043080	K	PM	D18			1		N	T	*A* RECIRC PUMP MG SET TRIPPED ON UNDER VOLTAGE	SHORT IN PUMP MOTOR
G	DA1	031421	052480	H	PT	C13			1		T	T	HPCI TURBINE WOULD NOT REACH RATED SPEED	LEAKING OIL SEAL ON TURBINE STOP VALVE
G	DA1	031422	052880	K	PM	D00	S		1		U	U	*B* RECIRC PUMP SECURED DUE TO HI/LOW LO ALARM	NO CAUSE FOUND FOR LOSS OF LUBE OIL LEVEL
G	DA1	031884	071180	Q	PT	B10	S		1		T	T	RCIC TRIP THROTTLE VALVE WOULD NOT OPEN ELECTRIC.	CORRODED CONTACTS ON MOTOR OP LIMIT SW.
G	DR1	000429	092873	D	PM	D19			1		U	T	1A CORE SPRAY PUMP INOPERABLE DUE TO SMOKING PKG	METALIC PKG SCORED SHFT SLV AND DISTORTED

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G	DR1	019321	100477	D	PM	D19				1	T	U	B CORE SPRAY PUMP PACKING OVR HEATED, BEGAN SMKING	PUMP LAST PKD 11/16/76, LAST TSTD 9/20/77
G	DR2	002284	030572	L	PM	B09	T			1	T	D	2C LPCI FAILD TO START DURING TEST	DIRTY CONTACTS IN 4KV ECCS BREAKERS
G	DR2	010808	101874	K	PM	A19				1	N	T	"B"RECIRCULATION PUMP SEALS LEAKING	LEAKING MECHANICAL SEAL
G	DR2	013460	092975	H	PT	C13				1	U	T	HPCI TURBINE FAILED TO TRIP AT DESIGN COOLANT LEVL	OPEN CKT IN COIL OF TRIP THTL SOLONOID VA
G	DR2	015195	062576	L	PM	B19	T			1	N	D	2C LPCI FAILD TO START FOR MAINTNG TORUS WTR. TEMP	DIRTY SWITCH IN 4KV BKR FOR PUMP
G	DR2	018931	091077	H	PT	C13				1	T	D	HPCI MOTOR SPEED CHGR FAILED TO BRING TURB GT 2800	LOSS OF PIN FROM MTR SPD CHNGR AND GEAR
G	DR2	022551	093078	H	PT	D13	S			1	T	T	HPCI TRIPPED ON LOW SUCTION PRESSURE	INST DRIFT OF PRESSURE SWITCH
G	DR2	023340	010379	H	PT	B00				1	T	U	HPCI PUMP FAILED TO START	CAUSE NOT STATED
G	DR2	025953	041579	L	PM	B00				1	T	U	2A LPCI PUMP WOULD NOT START	CAUSE UNKNOWN
G	DR2	032415	081880	L	PM	A09				1	N	T	2A LPCI PUMP SEAL FOUND LEAKING	SEAL FAILED DUE TO DIRT ON SEALING SURF.
G	DR3	002288	052072	H	PT	B13	S			1	T	U	HPCI TURBINE FAILED TO START REMOTELY	BROKEN WIRE ON THE TURBINE RESET SOLONCID
G	DR3	000055	060873	H	PT	B13	S			1	U	U	HPCI STEAM SUPPLY VALVE FAILED TO OPEN COMPLETELY	STEM OF THE VALVE WAS BENT
G	DR3	000717	011774	H	PT	B18				1	T	D	HPCI CONTROL VALVES FAILED TO OPEN	BURRS ON CYLINDER WALL AND PISTON
G	DR3	018549	080477	K	PM	C03	U			1	T	D	"A" RECIRC PUMP DID NOT RUNBACK DURIN FEED SYS TST	OPERATOR TURND OFF CONT.PWR TO "A" RECIRC
G	DR3	019911	121677	H	PT	C13	S			1	T	D	HPCI FLOW CONTRLLR FAILD TO CONTROL MOTOR GEAR	HPCI INOPERABLE;FAILD PWR SUPPLY IN CONVT
G	EN1	012382	011075	Q	PT	B02	S			1	N	D	RCIC TURBINE TRIPPED DURING AUTO START AFTER SCRAM	WIRING ERROR ON THE TURBINE GOVERNOR
G	EN1	012973	070175	L	PM	B13	S			1	T	D	RHR 1B AIR CKT BKR FAILD TO CLOSE	SLIPPD CAM IN LATCH ASY. OF ACB
G	EN1	012971	070575	Q	PT	C13				1	N	T	TURBINE SPEED CONTROL MALFNCTND SHAFT L.O. PUMP LO	WORN DRIVE GEARS (UPPR & LWR BUSHINGS)
G	EN1	013071	071375	Q	PT	B13	T			1	N	T	RCIC TURBINE TRIPPED ON OVERSPEED AFTER RX SCRAM	ELEC OVERSPD INST CONTAINED MALFN XSISTOR
G	EN1	013606	090675	Q	PT	B00				1	T	U	RCIC TURBINE TRIPPED ON OVERSPEED	COMPONENT FAILURE - NO PROBLEM FOUND
G	EN1	013907	111575	Q	PT	C13	R			1	N	T	RCIC MECHNCL OVERSPEED TRIP SETPOINT HIGH	RECALIBRATED MECHANICAL OVERSPEED
G	EN1	014773	022276	Q	PT	B11	T			1	N	D	RCIC TRIPPD ON MANUAL START--TRIPPD BY MECH OVRSPD	VIBRATION CAUSD VALVE TO UNLATCH ON S/U
G	EN1	014782	040976	R	PM	D02	S			1	N	D	RHR PUMP E11-C002C TRIPPED DURING FUNCTIONAL TEST	PUMP WAS WIRED INCORRECTLY
G	EN1	014789	042276	Q	PT	C02	U			1	T	D	RCIC TURBINE SPEED WOULD NOT INCREASE	PERSONNEL CUT CABLE TO PUMP (DUR OUTAGE)
G	EN1	017333	030777	Q	PT	C20	R			1	T	T	TURBINE SPEED INCREASED TO 5625 RPM ;DIDNT TRIP	OUT OF ADJUSTMNT TRIP LINKAGE ON MECH CS

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VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	EN1	018648	072777	Q	PT	B09	S		1	T	T	COULD NOT RESET RCIC TURBINE ; TRIP-THROTLE VALVE	DIRTY CONTACTS WOULD NOT ACTUATE VALVE
G	EN1	020023	092377	Q	PT	B02	S		1	T	D	RCIC TURBINE TRIP THROTTLE VALVE FAILD TO REOPEN	LOOSE BRUSH SPRING ON OPERATOR MOTOR
G	EN1	020153	120477	H	PT	C13	S		1	T	D	HPCI TURD GOVNOR STUCK,MANUALLY HAD TO FORCE GOVNR	DAMAGED ELEC. CONNECTOR ON FLEX CONDUIT
G	EN1	021481	050678	D	PM	B13	S		1	T	D	CORE SPRAY PUMP FAILED TO START (1A)	CONTROL SWITCH HAD BROKEN POSITION STOP
G	EN1	025369	022779	H	PT	D13			1	T	T	HPCI PUMP REQUIRED TO BE SECURED DUE TO VIBRATION	ACTUATOR ON TURBINE CONTROL LOOP FAILED
G	EN1	026419	072579	R	PM	A19			1	N	T	1C RHR PUMP HAD EXCESSIVE LEAK	MECHANICAL SEAL FAILURE
G	EN1	027818	120879	Q	PT	D09	S		1	N	T	RCIC TURBINE TRIPPED ON HIGH EXHUST PRESSURE	CLOGGED MANUAL CHECK VALVE
G	EN1	030243	012780	K	PM	D13	S		1	N	T	'A' RECIRC PUMP TRIPPED WHILE AT POWER	GROUND IN CONTROL CIRCUIT
G	EN1	031141	051380	H	PT	D13	T		1	N	D	HPCI FAILED TO START AFTER REACTOR SCRAM	SPURIOUS HPCI HIGH STEAM FLOW SIGNAL
G	EN1	031265	051480	Q	PT	D13	R		1	N	U	RCIC PUMP TRIPPED ON MANUAL START	BELIEVED TO BE OVERSPEED TRIP,UNKN CAUSE
G	EN1	031287	052080	H	PT	C13	S		1	T	T	HPCI TURBINE SPEED CONTROL FOUND ERRATIC	RAMP GEN IN EGM FOUND DEFECTIVE
G	EN1	031601	061380	Q	PT	D13	S		1	N	T	RCIC TURBINE TRIPPED FOLLOWING A REACTOR SCRAM	EGR AND LIMIT SW ON TRIP VALVE MALFUNCT.
G	EN1	031658	062680	H	PT	D13	T		1	N	U	HPCI FAILED TO START AFTER REACTOR SCRAM	HI STEAM LINE FLOW SIG DUE TO TURBINE CON
G	EN1	032130	072580	H	PT	C13			1	T	T	HPCI TURBINE FAILED TO TRIP AT OVERSPEED SETPOINT	WEAR TO TRIP DEVICE CAUSE SETPOINT DRIFT
G	EN1	033578	090680	L	PM	D02	S		1	T	D	"D" RHR PUMP VIBRATED OUTSIDE ASME CODE	WRONG REFERENCE DATA USED
G	EN1	032720	091980	H	PT	D00			1	T	U	DURING HPCI PUMP OP TEST,HPCI SYS ISOLATED	CAUSE UNKNOWN
G	EN2	022023	072578	Q	PT	B13	S		1	T	D	RCIC TURBINE FAILED TO START MANUALLY	SET POINT DRIFT OF OVERSPEED TRIP
G	EN2	022753	110678	H	PT	B02	U		1	T	D	HPCI PUMP FAILED TO QUICK START	WIRE ON CONTROL CIRCUIT NOT RECONNECTED
G	EN2	026030	060379	H	PT	B09			1	N	T	HPCI PUMP FAILED TO START-TURBINE STOP FAILD TO OP	WATER CONTAM OIL - SEAL LINE LEAKING
G	EN2	026035	060379	Q	PT	D12	S		1	N	T	RCIC PUMP FAILED TO RUN - RUPTURE DISC RUPTURED	DISCH CHK VLV DISC LOOSE - BLOCKED FLOW
G	EN2	026149	060879	H	PT	D18	S		1	T	D	HPCI PUMP BECAME INOPERABLE	VAC AND CONDENSATE PUMPS TRIPPED
G	EN2	026340	062779	Q	PT	D02	S		1	N	D	RCIC CONDENSATE PUMP TRIPPED	PERSONNEL STEPPED ON MOTOR CONNECTING BOX
G	EN2	027781	112979	H	PT	D01	S		1	T	D	HPCI PUMP AUX LUBE OIL PUMP TRIPPED	HPCI PUMP WAS BEING SECURED INCORRECTLY
G	EN2	030234	013080	H	PT	D13	S		1	T	T	HPCI AUX LUBE OIL PUMP TRIPPED	TIME DELAY COIL IN BKR FAILED
G	EN2	030834	041580	R	PM	B13	S		1	T	U	"D" RHR PUMP FAILED TO START ON LOCA SIGNAL	WIRE MISSING FROM TERMINAL NO.7 ON RELAY

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	EN2	030976	042280	Q	PT	D00			1	T	U	RCIC TRIP THROTTLE VALVE TRIPPED	UNKNOWN
G	EN2	031319	052180	Q	PT	D01			1	N	D	RCIC PUMP TRIPPED TWO TIMES FOLLOWING SCRAM	TEST POT SPEED CONTROL USED INSTEAD OF AU
G	FP1	011055	121274	R	PM	B18	S		1	T	D	RHR PMP 10P-3D FAILD TO START;REPLACED FAULTY BKR	BKR DC CHARGIN MOTOR BURNED OUT
G	FP1	012065	010275	Q	PT	C00			1	T	U	RCIC PUMP DID NOT ACHIEVE RATED FLO ON INI TEST	PASSED SUBSEQ TESTS, CAUSE UNKNOWN
G	FP1	012768	052275	Q	PT	D13	S		1	T	D	RCIC TURBINE TRIPPD;LOCAL TRIP LEVER ONLY PART ENG	READJUSTD TO FULLY ENGAGE
G	FP1	012769	052275	H	PT	D16	S		1	T	T	HPCI TURBINE TRIPPD ON LOW OIL PRESS.	LEAKS CAUSD A LOW OIL LEVEL &SYS. PRESSUR
G	FP1	013470	101175	H	PT	B09	S		1	T	D	HPCI STEAM SUPPLY 23MOV14 FAILD TO OPEN ON SIGNAL	PAPER HAD FALLEN BETWEEN OPERATR CONTACTS
G	FP1	013580	102975	H	PT	B04	T		1	T	D	HPCI AUTO STARTD THEN ISOLATD ON HI STEAM FLOW	SNUBBER PINS WERE RELOCATED
G	FP1	014488	032176	Q	PT	B03	U		1	T	D	BOTH EXHAUST RUPTURE DISKS RUPTURD DURIN FLOW TEST	MANUAL EXHAUST VALVE FULLY CLOSED
G	FP1	014486	040376	K	PM	D04	S		1	N	D	RECIRC PMP "A" TRIPPD DUE TO EXCITER OVERCURRENT	WATER LEAKAGE INTO CONTROL CABINET
G	FP1	015062	061976	Q	PT	C10			1	T	T	RCIC TURBINE WOULD NOT TRIP WHEN REQUIRED TO	RUSTY LINKAGE CAUSD BY STEAM LEAK
G	FP1	015236	063076	K	PM	D00	S		1	N	U	LOSS OF "B" RECIRC PUMP LOSS OF POWER DURIN TRANSF	BUS 10200 FAILD TO TRANSFER TO RECER. PWR
G	FP1	016375	110976	H	PT	B04	T		1	N	D	HPCI STARTD THEN ISOLATED ;NEED STEAM SIGNAL SNUB	FLOW SNUBBERS ELIMINATED THE PROBLEM
G	FP1	017329	022877	K	PM	D15	S		1	N	T	RECIRC PUMP MG SET TRIPPED ON LOW OIL PRESSURE	FAILURE OF THE DRIVE TO THE OIL PUMP
G	FP1	017338	030777	K	PM	C13	S		1	N	T	B RECIRC PUMP CONTROL RKT PROBLEM CAUSED SPEED MIS	RECIRC PUMP CONTROL CKT PROBLEM CAUSED SP
G	FP1	017408	031477	Q	PT	B04	S		1	T	D	RCIC TURBINE TRIPPD DUE TO LOW OIL LEVEL	AUX.OIL SUMP INSTALLD PER VENDOR F.D.I.
G	FP1	017934	052177	Q	PT	B11	S		1	T	D	RCIC TURBINE DAMAGED BY OVERSPEED	OIL LINE FAILURE-HI FREQUENCY VIBRATION
G	FP1	017933	060677	U	PM	A19			1	T	T	"B" STANDBY LIQUID CONTROL SYS PUMP PKG LEAKAGE	PACKING DEGRADED DUE TO AGE AND WEAR
G	FP1	019169	092877	Q	PT	B13	S		1	T	T	13 MOV131 STEAM SUPPLY TO RCIC TURBINE WOLDNT OPEN	TORQ SWITCH RESET SO VALV WOULD OPERATE
G	FP1	019296	100577	K	PM	D03	S		1	T	D	B RECIRC MG SET INADVERTNTLY TRIPPD,LOST "B" PUMP	OPERATOR ERROR DURING TEST
G	FP1	019869	122877	Q	PT	D09			1	N	T	RCIC PUMP 13-P-1 S/D TO ALLOW CLNG OF CUNO FILTER	CUNO OIL FILTER CLOGGED
G	FP1	021143	041078	Q	PT	C09	S		1	T	D	LIMIT SWITCH MALFUNCT ON 13MOV131--LOST SPEED CONT	DIRT ON CONTACTS CAUSD LOSS OF CONTINUITY
G	FP1	022504	091578	L	PM	B02	S		1	T	D	RHR PUMP 10-P-3C RENDERED INOPERABLE	CONTROL POWER FUSE HOLDER WAS BENT
G	FP1	027358	102079	L	PM	B13	S		1	T	T	RHR PUMP "C" FAILED TO START PROPERLY	LIMIT SWITCH NOT ADJUSTED PROPERLY
G	MI1	002363	082972	K	PM	A19			1	N	U	PRIMARY LEAK OF 5.61GPM TECH SPEC-5GPM	RECIRCULATION PUMP "A" SEALS LEAKING

ALL FAULTS CONSIDERED IN PUMPS

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G	MI1	001051	032173	H	PM	D21			1	N	U	COND BOOSTR "A" PUMP INBOARD BRNG FAILED	CAUSE NOT INDICATED
G	MI1	0101598	051774	H	PM	D19	R		1	N	U	FWCI COND BOOSTR "A" PUMP SEAL FAILED, SYS INOPERB	ING-RAND TYPE 10SH RECURING BRNG FAILR
G	MI1	0101598	051774	H	PM	B21	R		1	N	U	FWCI COND BOOSTR "B" PUMP BRNG FAILED, SYS INOPERB	BRNG FAILURE ON ING-RAND TYPE 10SH
G	MO1	002172	073172	H	PT	B09	U		1	T	U	HPCI TURBINE TRIPPD ON OVERSPEED FOLLOWING MAINT.	PLASTIC FRAGMENTS FOUND IN OIL INLET PORT
G	MO1	002168	101172	U	PM	C06	U		1	T	D	STBY LIQ CONT PUMP DIDNT DEVELOP REQD HEAD	IMPROPER VENTING/FILL OF SUCTION LINE
G	MO1	001162	051873	H	PT	C13	S		1	U	U	EXCESSIVE STEAM FLOW TO HPCI ISOLATED HPCT FROM RX	EXCESSIVE STEAM FLOW TO HPCI ISOLATED HPC
G	MO1	010267	052174	H	PT	B13	S		1	T	D	HPCI TURB AUX OIL PUMP FAILED TO START	ACCEL RELAY AUX CONTACT ASSY DISLOCATED
G	MO1	013712	111875	Q	PT	B10			1	T	T	RCIC TURBINE FAILD ON FAST START;STEAM CONTROL VLV	CORROSION AND CRUD ON VALV STEM AND PIVOT
G	MO1	014446	040576	Q	PT	B04	S		1	T	D	TURBINE TRIPPD ONCE ON HI EXHAUST LINE PRESSURE	RAISD TRIP SETPOINT FROM 25 TO 40 PSIG
G	MO1	015440A	080276	Q	PT	D11	T		1	T	T	RCIC TURBINE TRIPPED ON OVERSPEED	STEAM VOID IN DISCH PIPING - VLV LEAKAGE
G	MO1	015440B	083076	Q	PT	D11	T		1	T	T	RCIC TURBINE TRIPPED ON OVERSPEED	STEAM VOID IN DISCH PIPING - VLV LEAKAGE
G	MO1	018670	080577	H	PT	C13	S		1	T	T	GOVENOR CONTROL SYS. FAILD RESULTING IN LOSS OF OC	FAILD RESISTOR
G	MO1	026379	070279	H	PT	D05			1	T	T	HPCI GOVENOR END BEARING HAD HIGH TEMP AND VIBRA.	WORN LUBE OIL PUMP DUE TO WRONG METAL USE
G	NM1	002015	060172	D	PM	B13	T		1	U	D	CORE SPRAY PUMP FAILED TO START	CB FAILED - LNKGE TO AUX SWITCH BINDING
G	NM1	002016	060172	D	PM	B13	T		1	U	D	CORE SPRAY PUMP FAILED TO START	CB FAILED - BURNED CONT RELAY CONTACTS
G	NM1	002129	091972	K	PM	A19	R		1	N	T	RECIRC PUMP SEAL LEAKED EXCESSIVELY	NO CAUSE GIVEN - OTHER THAN LEAKY SEAL
G	NM1	000455	101873	K	PM	A19	R		1	N	T	RX RECIRC PUMP 12 HAD SMALL SEAL LEAK	NO CAUSE GIVEN - OTHER THAN LEAKY SEAL
G	NM1	010746	091774	F	PM	C05			1	T	D	#122 CNTMNT SPRAY FLOW 2600GPM VS. 3000GPM	2X4 PIECE OF WOOD WEDGED IN EYE OF PUMP
G	NM1	012284	021275	H	PM	B13	T		1	N	D	12 FEEDWATER PUMP FAILED TO START (HPCI COMPONENT)	LNKGE BET BOURDON TUBE AND SWITCH DISCONN
G	NM1	013016	061875	U	PM	B13	S		1	T	D	11 STANDBY LIQ CONT PUMP WOULD NOT START	POWER BRKR TRIGGER WAS NOT LATCHED
G	NM1	013416	091375	H	PM	B13	T		1	N	T	12 FEEDWATER PUMP FAILED TO START (HPCI COMPONENT)	OIL PMP MTR BRKR HAD LOOSE FUSE HOLDER
G	NM1	014245	021576	H	PM	D13	T		1	U	D	LOSS OF #12 FEEDWATER PUMP (HPCI COMPONENT)	LNKGE BET BOURDON TUBE AND SWITCH DISCONN
G	NM1	015624	080976	H	PM	B13	T		1	N	D	11 FEEDWATER PUMP FAILED TO START (HPCI COMPONENT)	AGASTAT FAILED TO FUNCTION PROPERLY
G	NM1	017284	102576	H	PM	A19			1	N	T	#12 FEED PMP TAKEN OUT OF SERVICE LEAKY SEAL STRNR	LEAKS IN SEAL STRAINR AND GEAR BOX
G	NM1	017431	040477	R	PM	D06	U		1	N	U	WHILE LOWRNG R/X H2O LEVEL FOR MAINTNCE ON VESSEL	SHUTDWN COOLNG PMP TRPPD DUE TO LOW SUCT

ALL FAULTS CONSIDERED IN PUMPS

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G	NM1	019586	110677	K	PM	A19		R	1	N	U	LEAK GT. 5GPM FORCD POWR REDCTN #15 RC PUMP	SEAL FAILD RPLCD SEALS ON #11,#14 PMP ALS
G	NM1	020253	012078	H	PM	B13		T	1	N	D	LOST POWER TO 11 FEEDWATER PUMP AFTER LOSS OF PWR	RESERVE PWR BRKR FAILED TO CLOSE
G	NM1	032570	082280	H	PM	A07			1	N	T	#11 REACTOR FEEDPUMP HAD EXCESS SEAL H2O LEAKAGE	NORMAL WEAR TO SEAL
G	OC1	002253	080172	F	PM	B13		T	1	U	D	CONTAINMENT SPRAY PUMP FAILED TO START	DIRTY CONTACTS ON BRKR POSITION SWITCH
G	OC1	002305*	080172	U	PM	B13		U	2	U	D	BRKR FOR 1 STBY LIQ CONT PUMP RACKED OUT-OTHER PMP	WOULD NOT START - AUX CONT PREVENTED OPE
G	OC1	000217	061873	F	PM	B13		T	1	U	D	CONTAINMENT SPRAY PUMP 51C DID NOT START	BROKEN WIRE TO KEY LOCK SWITCH
G	OC1	010834	101874	F	PM	B13		T	1	T	D	CONTAINMENT SPRAY PUMP 51A FAILED TO START	START CIRCUIT FAILURE - TIME DELAY RELAY
G	OC1	012029	021175	F	PM	B00		R	1	T	U	CONTAINMENT SPRAY PMP 51A FAILD TO START IN AUTO	UNDER INVESTIGATION
G	OC1	012330	030675	F	PM	B13		T	1	T	D	CONTAINMENT SPRAY PUMP 51A FAILED TO START IN AUTO	BRKR TRIP BAR FAILED TO RESET ON PREV TRP
G	OC1	013830*	121275	K	PM	D03		U	3	T	D	DEENERG 125V DC DIST CTR - LOSS OF 3 RECIRC PUMPS	PERSONNEL DID NOT FOLLOW PROCEDURES
G	OC1	013830A	121275	H	PM	D03		S	1	T	D	FEEDWATER PUMP TRIPPD DURING LOAD TEST OF BATTERY	PERSONNEL ERROR FOLLOWING PROCEDURES
G	OC1	014576	042376	D	PM	A19			1	N	U	INBOARD SEAL ON CORE SPRAY N201B CRACKD 3GPM LEAK	CARBON ROTATNG WASHR CRACKD CAUSE UNKNWN
G	OC1	016477	111176	F	PM	B13		T	1	T	D	CONTAINMENT SPRAY PUMP 51D DID NOT START	CB TRIP LATCH FAILED TO RESET
G	OC1	023118A	112678	F	PM	B13		T	1	T	D	CONTAINMENT SPRAY PUMP 51C FAILED TO START	EXCESS FRICTION IN POWER CIRCUIT BREAKERS
G	OC1	023119B	120278	F	PM	B13		T	1	T	D	CONTAINMENT SPRAY PUMP 51C FAILED TO START	EXCESS FRICTION IN POWER CIRCUIT BREAKERS
G	OC1	025518	032279	K	PM	D13		S	1	N	T	"C" RECIRC PUMP KEPT TRIPPING	LOSS OF GENERATOR FIELD,FAILED POTENIOMET
G	OC1	025827	041979	D	PM	B13		S	1	T	D	CORE SPRAY PUMP FAILED TO START ON SIGNAL (N201A)	FUSE FAILURE
G	OC1	025825A	050279	H	PM	B00			1	N	U	A FEED PUMP DID NOT OPERATE AFTER SCRAM	CAUSE NOT STATED
G	OC1	025825B	050279	H	PM	B13		U	2	N	D	B&C FEED PUMPS DID NOT OPERATE AFTER SCRAM	BUS DE-ENERGIZED
G	OC1	027695	110379	D	PM	B03		U	1	T	D	CORE SPRAY BOOSTER PUMP DID NOT START, LOOSE FUSE	PERSONNEL MANIPULATING FUSE FOR TEST
G	PB2	000673	121273	H	PT	D04		S	1	T	D	OIL LINE FAILD IN TURBINE CONTROL SYSTEM	SHEAR FAILURE IN THREADED PIPE SECT
G	PB2	000641	122473	G	PT	B06		S	1	T	D	TURBINE TRIPPD ON 3 OCCASIONS;IMPROPR ADJUSTMENT	LINKAGE BETWEEN TRIP VALVE AND OS TRIP
G	PB2	000933	032474	H	PT	B13		T	1	T	U	TURBINE CONT VALVE AO-16C FAILD TO OPEN POSITION	OPEN CKT. CAUSD BY FAILD LOCAL SPEED PCT.
G	PB2	000989	041674	H	PT	B13		S	1	T	T	TURBINE ISOLATED UPON AUTO INITIATION; HI STEAM FL	RAMP GENERATR OUT OF CAL GAVE HI FLOW IND
G	PB2	010051	042774	H	PT	B04		S	1	T	D	TURBINE ISOLATED AFTR COLD QUICK START ON HI FLOW	AIR ACCUMULATES IN HYD.CYL OF STOP VALVE

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G	PB2	G10179	050774	Q	PT	B13	Z		1		T	U	OUTBOARD ISO. VALVE MOV12-16 FAILD TO OPEN	MOTOR FAILURE;REPLACED DURIN SHUTDOWN
G	PB2	015233	071976	H	PT	C13		T	1		T	T	TURBINE SPEED COULD NOT BE CONTROLLED	FAILD ELECTRONIC PARTS IN SPEED CONT.SYS.
G	PB2	016142	100576	Q	PT	B13	S		1		T	U	RCIC TRIP THROTTLE VALV WOULDNT RESET AFTR TRIPPIN	GROUNDED WIRE ON TRIP SOLENOID
G	PB2	016779	122876	Q	PT	B13	T		1		T	D	STEAM SUPPLY ISO. VLVE MO-23-15 FAILD TO OPEN	FAILD CLOSE TORQ SWITCH DAMAGD VLVE MOTOR
G	PB2	019187	092677	H	PT	B13			1		T	T	HPCI INOPER--OIL LEAK ON HPCI OIL CONTROL VALVE	LEAKING DIAPHRAM; REPLACED WITH NEW DIAPH
G	PB2	020526	020778	H	PT	B02	U		1		T	D	TURBINE TRIPPD ON OVERSPEED; AUTO START TESTIN	MISCALIBRATION OF TURBINE SPEED CONTROL
G	PB2	021681	042978	L	PM	U01	U		2		N	D	UNIT 2 MBM,HDRHR BLOCKED FOR 2 HRS.	OPERTR REMVD UNIT 2 INSTED OF UNIT 3 PRPS
G	PB2	022284	090178	H	PT	B18			1		T	T	AUX OIL PUMP FOR HPCI SYS FAILED TO START	GROUND IN MOTOR
G	PB3	010672	091874	R	PM	D18			1		N	U	"B" RHR PUMP MOTOR EXPERIENCED SHORT TO GROUND	RANDOM INSULATION FAILURE
G	PB3	011017	112574	H	PT	B00			1		T	U	DURIN 100 PERCENT ISOLATION TEST, HPCI ISOLATED BY	A TRANSIENT --CAUSE NOT IDENTIFIED
G	PB3	012013	021675	U	PM	B13	S		1		T	D	STANDBY LIQUID CONTROL PUMP FAILED TO START	OVE PHASE TRIP DEVICE MARGINALLY ADJUSTED
G	PB3	014518	042976	H	PT	B13	S		1		N	D	HI STEAM FLOW TRIPPD HPCI TURBINE FOLLOWING SCRAM	RAPID OPENING OF TURBINE STOP VALVE
G	PB3	018416	072177	H	PT	C13			1		T	U	TURBINE SPEED CONTROL ERRATIC;RCIC WAS OUT OF SERV	BENT LIFT RODS IN TURBINE CONTROL VALVE
G	PB3	019714	093077	H	PT	C13	S		1		T	U	HPCI FLOW CONTROLLR FC-3-23-108 DEFECTIVE	CIRCUIT BOARD TROUBLE FAILD
G	PB3	019831	111477	U	PM	A07			1		N	T	STDBY LIQUID CONTROL PMP 38P40 OUT OF SERVICE	REPLACE PACKING PREVNTV MAINTENANCE
G	PB3	020273	011378	U	PM	B13	S		1		T	T	STANDBY LIQUID CONT PUMP 3A DECLARED INOPERABLE	MK VACUM DEPRESS - CHGING VALVE FAILED OP
G	PB3	022480	080978	H	PT	C13	S		1		N	T	HPCI PUMP FAILED TO REACH RATE FLOW	HIGH AND LOW SPEED POTENTIOMETERS OOC
G	PB3	022852	110679	H	PT	D13	R		1		N	T	HPCI PUMP APPARENTLY TRIPPED ON OVERSPEED	GOVENOR OUT OF CALIBRATION
G	PB3	023446	102279	R	PM	D18			1		N	T	"A" RHR PUMP TRIPPED WHILE PROVIDING S/D COOLING	MOTOR FAN EXPERIENCED FATIGUE FAILURE
G	PI1	002247	100772	J	PM	D13	U		2		T	D	POWER CTR UNDERVOLT TRIP - LOSS OF CCW PUMP	LOADED PC SIMULTANEOUSLY VS SEQUENTIALLY
G	PI1	002229	120872	Q	PT	D07			1		T	T	RCIC TURBINE OIL PRESS LOST WHILE OPERING IN TEST	WORN GEARS IN DRVE TRAIN OF SHFT L.O.PUMP
G	PI1	001079	011677	H	PT	C13	S		1		T	D	HPCI TURBINE TRIPPED ON OVERSPEED DURING START	TEST PROCEDURE USED WAS INADEQUATE
G	PI1	001043	041378	J	PM	D13	T		1		U	D	RBCCW PUMP TRIPPED BY 480V MOTOR CONTROLLER	OVERLOAD RELAY NOT FUNCTIONING PROPERLY
G	PI1	000044	091173	J	PM	D13	T		1		N	D	RBCCW PUMP 202-5 TRIPPED BY OVLD RELAY IN MTR CONT	THERMAL HTR IN CONT NOT HI ENOUGH AMPRAGE
G	PI1	000971*	032074	J	PM	B13	S		2		T	D	"B" RBCCW PUMPS DID NOT AUTO START	PRESS SW MALFUNCTION-MICRO SW OUT OF ADJ

ALL FAULTS CONSIDERED IN PUMPS

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G	PII	011041	110874	Q	PT	D00		S	1	T	U	RCIC STEAM SUPPLY LINE ISOLATED DUE TO SPURIOUS S	NO CAUSE IDENTIFIED
G	PII	012441	031975	D	PM	B18			1	T	U	"A" CORE SPRAY PUMP TRIPPED ON START	FAULTY MOTOR WINDING - INSULATION
G	PII	013113	060875	Q	PT	B00			1	T	U	OVERSPEED TRIP OF TURBINE DURING STARTUP	NO APPARENT CAUSE
G	PII	018410	032377	J	PM	D13	T		1	U	D	"E" RBCCW PUMP INOPERABLE - BKR TRIPPED ON OVLD	OVERHEATING OF BLOCK TYPE OVLD RELAY
G	PII	019593	100977	D	PM	B13	S		1	T	D	CORE SPRAY PUMP P-215B FAILED TO START	INCORRECT LOGIC CLSNG SCHEME FOR CIR BRKR
G	PII	020675	030578	H	PT	B09	S		1	N	T	TURBINE STOP VALVE FAILD TO OPEN AFTR REACTOR SCRM	DIRTY DUPLEX OIL FILTER
G	PII	020884	032378	D	PM	B13	S		1	T	D	CORE SPRAY PUMP "A" DECLARED INOPERATIVE	LOOSE CONN ON SPRING CHARGING LIMIT SWICH
G	PII	023395	123078	H	PT	D19			1	T	U	HPCI PUMP TRIPPED IN FULL FLOW TEST	OIL FITTING LEAKED AND LOST LUBE OIL
G	PII	025165	021479	H	PT	D13	S		1	T	U	HPCI TURBINE TRIPPED DURING TEST	GASKET ON GLAND SEAL CONDENSER RUPTURED
G	PII	025707	041579	Q	PT	D13	S		1	T	D	RCIC CONDENSATE PUMP TRIPPED	BAD RELAY IN PUMP START LOGIC
G	PII	031177	051380	D	PM	B13	T		1	T	D	CORE SPRAY PUMP P-215B FAILED TO AUTO START	BKR 152-607 EXPERIENCED A TRIP FREE OP.
G	PII	031557	053080	Q	PT	C13	S		1	T	T	RCIC TURBINE FLOW AND PRESSURE DID NOT MEET T.S.	AUTO FLOW CONTROL FOUND FAULTY
G	QC1	002210	101972	D	PM	B13	S		1	T	D	1B CORE SPRAY PUMP FAILED TO START DURING TEST	IMP ADJ AUX CONT IN BREAKER NO. 1422
G	QC1	000879	031074	Q	PT	B13	S		1	T	T	RCIC INOPERATIVE;TURBINE STEAM INLET VALVE 1301-61	EXCESSIVE WEAR CAUSD CAM AND TRIP LEVER
G	QC1	010516	072074	H	PT	C01	U		1	T	D	HPCI SPEED CHANGR MOTOR INOPER. CONT.POWR FUSES BL	SYS.IMPROPRLY TAKEN OUT OF SERVICE EARLER
G	QC1	014539	032576	U	PM	C14			1	T	T	"B" SBLC SYS PUMP HAD DISCH PRESS FLUCTUATIONS	INTERNAL CHK VLVS WERE LEAKING
G	QC1	015194	061776	H	PT	C13			1	T	D	SPEED CHANGER MOTOR FAILD TO OPERATE	BOUND DUE TO INADEQUATE LUBRICATION
G	QC1	016457	102976	Q	PT	C14			1	T	U	OPERBLTY SURVEILNC OF RCIC PMP COULDNT MEET TECHS	5 STAGES WERE SEVERLY DAMAGED
G	QC1	016904	120276	L	PM	B02	U		1	U	D	AIR LOCKD SUCT HEADR COMMON TO 1A RHR LOOP,DIESL C	RHR SER WTR PMP HAD AIR LINE CONN TO CASE
G	QC1	020596A	012378	Q	PT	C09			1	T	T	RCIC PUMP TURBINE SPEED ERRATIC	DIRTY CONT LNKGE STICKING DURING OPERATN
G	QC1	021437	050578	Q	PT	D09	R		1	T	T	RCIC PUMP REPEATEDLY TRIPPED ON OVERSPEED TRIP	DIRTY BALL AND TAPPET ASSEM. ON O.S. TRIP
G	QC1	022190	080778	Q	PT	D13	R		1	T	D	RCIC TURBINE TRIPPED ON OVERSPEED TEST	BALL AND TAPPET ASSEM BENT, REPLACED
G	QC1	031190	042980	K	PM	D13	S		1	N	D	1A RECIRC PUMP TRIPPED WHEN MG LUBE OIL PUMP TRIP	CAUSE UNKNOWN WHY LUBE OIL PUMP TRIPPED
G	QC2	002211	102172	H	PT	B00			1	T	U	HPCI TURBINE STOP VALVE WOULD NOT OPEN	CAUSE NOT DETERMINED
G	QC2	010592	083174	H	PT	B13	S		1	N	D	HPCI WOULDNT START BECAUSE VALVES WOULD NOT OPER.	250 VDC BATTRY DISCHRGD;CHRGR BKR TRIPPD

ALL FAULTS CONSIDERED IN PUMPS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	QC2	012799	041875	D	PM	B13		S	1		T	D	CORE SPRAY PUMP 2B FAILED TO AUTO START	LOOSE TERMINAL CONN ON CONT PANEL 902-33
G	QC2	012801	041875	H	PT	B04			1		T	D	HPCI TURBINE STOP VALV WOULDNT OPEN DURNG ACT TEST	AUX OIL PMP AUTO TRIPPD WHEN EMER OIL PAN
G	QC2	013025	072975	H	PT	C13			1		T	U	TURBINE DRIVEN HPCI PUMP FLOW RATE INADEQUATE	IMPROPER PINNING OF PILOT VLV LEVER ARM
G	QC2	013257	083075	H	PT	B16		S	1		T	U	HPCI SYS. INOPERABLE DUE TO BREAK IN HI PRESS OIL	HI PRESS OIL DISCHARGE LINE REPLACED
G	QC2	013258	083075	Q	PT	D13			1		T	T	RCIC PMP TURBINE KEPT TRIPPING AT 3500 RPM	WORN NUT IN OVERSPEED TRIP MECHANISM
G	QC2	014098	123175	Q	PT	B05			1		T	D	TRIP THROTTL VLVE MECHANICAL OPERATOR WOLDNT RESET	REPLACEMENT TAPPET LONGER THAN ORIGINAL
G	QC2	017356	012877	H	PT	C00			1		T	U	HPCI FLOW DESIRED COULD NOT BE OBTAINED	APPEARS TO BE A TURBINE PROBLEM
G	QC2	017257	020977	H	PT	B09		S	1		T	T	TURBINE FAILD TO START DUE TO EXCSSV OIL PRESSURE	DIRT CLOGGD ORIFICE CONTROLING OIL PRESS.
G	QC2	019540	101377	K	PM	D13		T	1		N	T	2A RECIRC PUMP M/G FAILED - LOST 2A RECIRC PUMP	LOOSE TACH COUPLING - GENERATOR VIBRATION
G	QC2	0205968	020678	Q	PT	D13			1		T	U	RCIC PUMP TURBINE TRIPPED AT 3700 RPM	IMPROPER TENSION ON A SPRING - READJUSTED
G	QC2	021790	061478	H	PT	C13			1		T	T	HPCI TURBINE SPEED COULD NOT SE OBTAINED	JAM NUT ON ROD END BECAME LOOSE
G	QC2	025430	022379	K	PM	D13		T	1		N	T	2A RECIRC PUMP TRIPPED	MG SET TACHOMETER COUPLING FAILD
G	QC2	032646	082980	K	PM	D13		S	1		N	T	"A" RECIRCULATION PUMP MG FIELD BKR OPENED	FAILED CONTROL POWER TRANSFORMER
G	VY1	016997	011877	L	PM	B13		S	1		T	D	"D" RHR PUMP WOULD NOT START	A LOOSE LEAD IN A BREAKER CAUSED FAILURE
G	VY1	030058	010380	H	PT	D13			1		T	U	HPCI PUMP TRIPPED AFTER STARTING	HI EXHUST PRESSURE OR AUTO ISOLATION
G	VY1	030286	012880	H	PT	B13			1		T	T	HPCI PUMP GOVENOR VALVE WOULD NOT REOPEN	SHORT BETWEEN EGM & EGR ACT OR STUCK EGR
G	VY1	030734	032680	H	PT	C13			1		T	T	HPCI PUMP WOULD NOT INCREASE ABOVE 800 RPM	FAILED FLOW CONTROLLER

ALL COMMON CAUSE FAULTS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
B	AR1	013015	070775	G	PM	B01	C	1	N	D	P36C M/U PUMP STARTED AND IMMED TRIPPED, PUMP FRZN	RAN WITH NO SUCTION-INCORRECT VLV LINE-UP
B	AR1	026491	062179	B	PT	B01	U	1	N	D	EFW PUMP P7A KEPT TRIPPING ON OVERSPEED	WATER IN STEAM LINES DUE TO TRAPS ISOLATE
B	CR3	017938*	052977	I	PM	B00	V	2	N	U	CHEM ADD PMPS 3A & 3B FOUND INOP FOR PLANT S/U	CAUSE UNKN, PUMPS FLUSHED, RTND TO SERV
B	CR3	018400*	070977	I	PM	C11	V	2	N	D	DISCOVD CHEM ADD PMPS 3A & 3B INOP, PLANT AT POWER	PUMP BELIEVED AIRBOUND, VENT VLV INSTALED
B	CR3	022309*	080278	I	PM	C11	V	2	T	D	CHEM ADD PUMPS FAILED TO DEVELOP DISCHARGE PRESS.	CAP1A AND 1B BECAME AIRBOUND
B	DB1	019426	101677	B	PT	D04	B	1	T	D	GOVNR CLOSED ON AFP 1-2	VIBRATION CAUSING GOVNR TO CLOSE-DESIGN
B	DB1	019531	110877	B	PT	B04	B	1	N	D	GOVNR VALVE CLOSED DUE TO SURGING VIBRATIONS	NO FORCE TO HOLD GOVNR OPEN--MOD. REQUSTD
B	DB1	019712*	112977	K	PM	D13	O	4	N	D	ALL 4 RCP'S TRIPPD DUE TO LOSS OF 13.8 KV POWER	REACTOR/TURBINE TRIP OCCURED AT 2243.HOUR
B	DB1	020274*	011278	F	PM	U01	N	2	N	D	BOTH CONT SPRAY PMPS INOPERABLE R/X IN MODE 4	PUMP CKT.BKRS. RE-ENERGIZED
B	DB1	022690	091578	J	PM	D01	U	1	N	D	COMP. COOLING WATER PUMP 2 TRIPPED	PERSONNEL DID NOT REOPEN HX OUTLET VALVE
B	DB1	025525A	010379	G	PM	C04	U	1	T	D	HPI PUMP 1-1 FAILED TO DEVELOP SUFFICIANT RECIRC	HEAT TRACE UNABLE TO MAIN LINE ABOVE FREZ
B	DB1	025525B	010379	G	PM	U04	U	1	T	D	HPI PUMP 1-2 MAY NOT HAVE HAD SUFF. RECIRC	HEAT TRACE UNABLE TO MAIN LINE ABOVE FREZ
B	DB1	025139	011579	K	PM	B01	U	1	N	D	RCP 1-2-2 STARTED WITH INCORRECT BKR ALIGNMENT	PERSONNEL ERROR
B	DB1	027335*	101579	K	PM	D13	O	4	N	U	LOSS OF OFFSITE POWER CAUSED LOSS OF ALL 4 RCPS	LOSS OF OFFSITE POWER-OUTPUT BRKR FAULT
B	DB1	031610	062380	G	PM	U01	C	1	N	D	HPI PUMP 1-1 BEARING THERMOCOUPLE WELLS BROKEN	ASSUMED TO BE STEPPED ON
B	DE1	014806A	012876	L	PM	B02	U	1	T	D	LOW PRESS INJECTION PUMP 1A - INOPERABLE	INCORRECT SUBSTITUTE BREAKER INSTALLED
B	DE1	014806B	012876	F	PM	B02	U	1	T	D	REACTOR BUILDING SPRAY PUMP - INOPERABLE (1A)	INCORRECT SUBSTITUTE BREAKER INSTALLED
B	DE1	014806C	012876	G	PM	B02	U	1	T	D	HIGH PRESSURE INJECTION PUMP - INOPERABLE (1A)	INCORRECT SUBSTITUTE BREAKER INSTALLED
B	DE2	000577	111273	L	PM	B01	U	1	T	D	LOW PRESSURE INJECTION PUMP 2B FAILED TO START	BREAKER NOT RACKED IN PROPERLY
B	RS1	011151	103074	B	PM	B01	C	1	N	D	AUX PMP SEAL RINGS FROZN TO BUSHNGS AND BSHN TO SH	OPERATR FAILD TO OPEN SUCTN VALV TO FEED
B	RS1	016711	112376	F	PM	B01	U	1	T	D	RX BLDG SPRAY PUMP FAILED TO START	BRKR WAS NOT RACKED IN CORRECTLY
B	TI1	014220	021776	G	PM	B06	C	1	T	D	"A" MAKEUP/PURIF PMP STARTED WITH IMPROPR VALV L/U	PMP FAILURE DUE TO INAD PROCEDRES/PERSONL
B	TI1	020997*	031878	G	PM	D13	U	2	T	D	THE 1A & 1C MAKEUP PMPS TRIPPED ON XFER TO STTE PR	MALFUNC TIME DELAY RELAY IN LOW L.O. CKT
C	AR2	031023A	040780	B	PM	C11	U	1	N	D	BOTH TRAINS OF EFW PUMPS CAVITATED AFTER LOSS OF P	FORCED FLOW STOPPED IN FW SYS OH WATER
C	AR2	031023B	040780	B	PT	C11	U	1	N	D	BOTH TRAINS OF EFW PUMPS CAVITATED AFTER LOSS OF P	FORCED FLOW STOPPED IN FW SYS OH WATER

ALL COMMON CAUSE FAULTS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
C	CC1	026235	050779	R	PM	D03	U		1		N	D	#11 LPSI PUMP WAS STOPPED WHILE IN RHR MODE	SPURIOUS RECIRC ACT SIG BY PERSONNEL TEST
C	CC2	022604*	092478	R	PM	D13	U		2		N	T	BOTH LPSI PUMPS TRIPPED BY RAS SIGNAL	LEVEL INDICATOR FOUND TO BE OUT OF CAL.
C	CC2	022646*	101778	R	PM	C06	U		2		N	D	BOTH 21 AND 22 LPSI PUMPS LOST SUCTION	AIR LEAKED FROM PURIFICATION SYS TO SDC
C	FC1	025844	042079	F	PM	B01	U		1		T	D	CONTAINMENT SPRAY PUMP FAILED TO START (SI-38)	SUPPLY BREAKER BOUND DUE TO PERSONNEL ER.
C	MI2	025576	031479	R	PM	C11	U		1		N	D	LPSI PUMP LOST SUCTION DURING S/D COOLING	PUMP BECAME AIRBOUND
C	MI2	031945	070380	H	PM	D06	C		1		T	D	'A' HPCI PUMP SEIZED	PROCEDURE DID NOT REQUIRE MIN FLOW VLV OP
C	MY1	002322	120272	H	PM	B02	U		1		T	D	HPSI P-145 SUPPLIED BY "A" DG DID NOT START	GROUNDING BLOCK NOT REMOVED FROM CKT BKR
C	MY1	027208	091879	F	PM	C03	U		1		T	D	'B' TRAIN CONTAINMENT SPRAY PUMP DIS PRESS DROPPED	SUCTION VALVE WAS CLOSED
C	PA1	013008	070975	L	PM	C01	U		1		T	D	LPSI PUMP 67B NO FLOW, NO PRESSURE	TWO VALVES NOT IN CORRECT POSITION
C	SL1	017833*	041577	K	PM	D13	L		4		N	D	LOSS OF SEAL CLNG WTR TO RCPS - RCPS WERE SECURED	CONTAINMENT INST AIR SYSTEM FAILED
C	SL1	017935*	051677	K	PM	D13	N		4		N	D	LOST ALL FOUR REACTOR COOLANT PUMPS	LOSS OF OFF-SITE POWER
W	BV1	018241*	071977	K	PM	D04	N		3		T	D	LOAD REJECT. TEST FROM 50% PWR;PMPS TPIPPD UNDRFRQ	TURBINE CONTROL DESGN CONCEPTS
W	BV1	022396*	090478	R	PM	C11	V		2		N	D	A AND B RHR PUMPS WERE RUNNING WITH NO DISCH FLOW	PUMPS BECAME AIR BOUND WITH RCS DRAINED
W	BV1	026841	081679	G	PM	D02	C		1		T	D	1C CHARGING PUMP BECAME INOPERABLE	FAILED BEARING DUE TO A COOLING VLV SHUT
W	BV1	026984*	081979	K	PM	D01	N		3		N	D	ALL THREE RCPS TRIPPED ON UNDERFREQUENCY	OPERATOR ERROR
W	BV1	030879*	040880	R	PM	C06	V		2		N	D	RHR PUMPS BECAME AIRBOUND WHILE INCREASING FLOW	PROCEDURE REVISED TO VENT PUMPS
W	BV1	030880*	041180	R	PM	C11	V		2		N	D	'A' AND 'B' RHR PUMPS COULD NOT DEVELOP FLOW	PUMPS BECAME AIRBOUND
W	BV1	032789	091780	G	PM	D02	U		1		T	D	1C HIGH HEAD CHARGING PUMP BEARING TEMP INCREASED	CHECK VALVES INSTAL BACKWARDS IN COOL H2O
W	DC2	032628	090480	L	PM	C06	U		1		T	D	EAST RHR PUMP WAS FOUND UNSTABLE	ALL AIR WAS NOT REMOVED FROM SERVICE
W	HN1	015097	061776	R	PM	D06	U		1		N	D	R/X SHUTDOWN & REFUELING LOST PWR TO RHR PMP--2MIN	OVERLOADED 480V BUS PROCEDURES DEFICIENT
W	HN1	015218*	070576	B	PT	C11	U		2		N	T	AUX FEED PMPS WOULD NOT DEVELOP PROPER DISCH PRESS	BOTH PUMPS VAPOR BOUND - FAULTY CHK VLV
W	IP2	010282	051074	H	PM	B09	U		2		N	T	#23 & #21 HPSI PUMP STARTED ONLY DEVELOP 700# PRS	BORIC ACID LEAKAGE CAUSD SUCTION BLOCKAGE
W	IP2	015920*	080576	H	PM	C03	N		3		T	D	ALL 3 SAFETY INJ PUMPS RUN APPX 10 MIN W/O SUCTION	CHN PUMP SUCTION VLV (846) NOT OPEN
W	JF1	022631*	091778	F	PM	U01	U		2		N	D	BOTH CONTMT SPRAY PMP SUPPLY BREAKERS TAGGED OPEN	BOTH TRAINS REQUIRED BY TECH SPECS
W	JF1	027639	110379	B	PT	D03	U		1		T	D	AUX FEED PUMP TRIPPED ON OVERSPEED	MANUAL SPEED ADJUST LEFT MISADJUSTED

ALL COMMON CAUSE FAULTS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	JF1	030322*	021480	B	PM	B04	U	2	T	D		A&B AUX FEED PUMPS FAILED TO AUTO START	INADEQUATE DESIGN CHANGE CONTROL
W	KE1	010646*	080174	B	PM	B03	U	2	T	D		TWO AFP'S DID NOT START UNTIL THIRD ATTEMPT	DID NOT ALLOW OIL PRESS TO BUILDUP
W	KE1	010644	081974	J	PM	B02	U	1	N	D		COMP COOL PMP 1A DID NOT START PM ON 8/16/74	CKT BKR NOT RACKED IN FULLY
W	NA1	025716	040879	G	PM	U01	U	1	N	D		1A&1B OOS FOR MAINT, 1C FEEDER BRKR NOT RACKED IN	IMPROPER TAGOUT PROCEDURE
W	PR1	028041	122878	B	PT	D13	U	1	T	D		NO. 11 AUX FD PUMP TRIPPED OFF-LINE AT END OF TEST	STEAM SUPPLY VALVE TRIPPED ON OVERLOAD
W	PR2	021038	041778	L	PM	U01	U	1	N	D		OPERATOR PLACED #22 RHR PUMP OOS - AUX OPER OPENED	CKT BRKR FOR # 21 RHR PUMP - PERSONNEL ER
W	RG1	000629*	121473	B	PM	C11	U	2	T	D		AUXILIARY FEED PUMPS A & B LOST SUCTION	AIR IN SUCTION HEADER
W	RO2	000184*	070973	H	PM	B02	U	2	U	D		SAFTY INJECTION PMPS "B"&"C" TRIPPD ON MANUAL STAR	INSTANTNS TRIP SETTINGS WERE SET AT MIN.
W	RO2	018138*	060777	G	PM	C11	V	2	N	D		B & C CHGNG PUMPS RUNNING - PSZR LVL STILL FALLING	PUMP AIR BOUND - TYPE TX-150
W	RO2	019345	062277	G	PM	C11	V	1	N	D		"C" CHGNG PMP WOULD NOT CONTROL PSZR LEVEL	PUMP WAS AIR BOUND - TYPE TX-150
W	RO2	019793A	112377	H	PM	U01	N	3	N	D		BREAKERS FOR ALL 3 SAFETY INJ PMPS FOUND RACD OUT	FAILURE TO RECOG TS LIMIT FOR GT 200 F OP
W	RO2	019793B	112377	F	PM	U01	N	2	N	D		BREAKERS FOR BOTH CONT SPRAY PMPS FOUND RACD OUT	FAILURE TO RECOG TS LIMIT FOR GT 200 F OP
W	RO2	022614*	100378	F	PM	C06	U	2	T	D		BOTH OF THE CONTAINMENT SPRAY PUMPS FOUND AIRBOUND	PUMPS NOT VENTED AFTER SYSTEM REALIGNED
W	SA1	016938	010877	B	PT	B01	U	1	N	D		#13 AUXILIARY FEEDWATER PUMP FAILED TO START	PERSONNEL ERROR - TURB WAS MANUALLY TRIPD
W	SA1	017700A	050677	H	PM	U01	U	2	R	D		BOTH SI PUMPS AND 1 CENTRIFUGAL CHG PMP TAGGED OUT	PERSONNEL ERROR - NOT FOLLOWING PROCEDURE
W	SA1	017700B	050677	G	PM	U01	U	1	R	D		BOTH SI PUMPS AND 1 CENTRIFUGAL CHG PMP TAGGED OUT	PERSONNEL ERROR - NOT FOLLOWING PROCEDURE
W	SA1	028119A	042479	R	PM	D06	V	1	N	D		OPERATING RHR PUMP TRIPPED OFF OF LINE	INADEQUATE WORKING PROCEDURES
W	SA1	028119B	050879	R	PM	D06	V	1	N	D		OPERATING RHR PUMP TRIPPED OFF OF LINE	INADEQUATE WORKING PROCEDURES
W	SA1	028119C	063080	R	PM	C04	U	1	N	D		RHR PUMP LOST SUCTION	LOW LEVEL LIMIT WAS TOO LOW FOR RX WATER LE
W	SU2	000519	111373	H	PM	B02	U	1	U	D		SAFETY INJ/CHG PUMP 2-CH-P-1B DID NOT START-MANUAL	FUSES WERE NOT INSTALLED IN CONT CIRCUITS
W	TR1	014145A	011676	B	PD	B01	U	1	N	D		AUX FEED PUMPS FAILED TO START AUTOMATICALLY	MISLOGGING OF LIFTED LEAD IN AUTO-STA CKT
W	TR1	014145B	011676	B	PT	B01	U	1	N	D		AUX FEED PUMPS FAILED TO START AUTOMATICALLY	MISLOGGING OF LIFTED LEAD IN AUTO-STA CKT
W	TR1	018991*	082177	K	PM	D01	N	4	N	D		POWER TO RCPS INADVERTENTLY DEENERGIZED	GEN OUTPUT BRKR WAS TRIPPED PREMATURELY
W	TU3	010136	050374	H	PM	C11	U	1	N	D		SAFT INJ PMP STOPPD WHEN LOW RUN CURRNT/PRESS SEEN	AIR LEAKAGE INTO PUMP CASING
W	TU3	010135A	050874	B	PT	B06	C	2	T	D		DURNG START TEST A & B AUX FEED FAILD TO START	PACKING TOO TIGHT DEFECTVE PROCEDURES

ALL COMMON CAUSE FAULTS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
W	TU4	000095*	061873	B	PT	B02	U	3	N	D			AUTO START OF AUX FD PMPS DID NOT OCCUR ON SCRAM	FUSES FOR AUTO-START LOGIC CKT NOT INSTLD
W	ZI1	010081	042774	F	PM	B06	U	1	U	D			1B CONTAINMENT SPRAY PUMP DID NOT START	BRKR RACKED IN TO WRONG POSITION
W	ZI1	010718	071174	B	PT	B02	U	1	U	D			AUX FD PUMP 1A FAILED TO START FROM CONT RM	AUX FD L.O. PUMP PWR SUPPLY BKR WAS OPEN
W	ZI2	0008938	021174	B	PM	D11	B	1	U	D			AUX FD PUMP 2B HAD PREVIOUSLY FAILED	APPARENTLY DAMAGED FROM AIR BINDING
W	ZI2	000814	021574	B	PT	B11	V	1	T	D			2A AUX FEED PUMP STARTED,BUT TRIPPED ON OVERSPEED	AIR WAS ASPIRATED INTO THE PUMP
W	ZI2	000893A	021574	B	PM	C11	V	1	N	D			2C AUX FD PUMP STARTED - DISCH PRESS DID NOT RISE	AIR BINDING OF PUMP IMPELLER
W	ZI2	016051*	091976	K	PM	D01	U	2	N	D			TWO RCPS WERE INADVERTENTLY TRIPPED OFF-LINE	PERSONNEL MADE SWITCHING ERROR
G	BF1	000518A	111073	H	PT	U13	N	1	N	U			HPCI INOPERABLE UNTIL MANUALLY RESET	TRIP LOGIC IMPROP DESIGNED FOR LOSP
G	BF1	0005188	111073	Q	PT	U13	N	1	N	U			RCIC INOPERABLE UNTIL MANUALLY RESET	TRIP LOGIC IMPROP DESIGNED FOR LOSP
G	BF1	010171*	051374	R	PM	D02	U	2	T	D			RHR PMPS TRIPPD DUE TO ISOLATION VALVES CLOSING	FAULTY RELAYS FOR FCV74-47 AND FCV74-77
G	BF1	010377*	061874	D	PM	B13	U	2	T	D			1B & 1C COR SPRA DIDNT START DURIN SURVLLNC TESTIN	BENT CONTACT ARM ON RELAY (MANUAL START)
G	BF1	027159*	092679	K	PM	D03	V	2	N	D			A AND B RECIRCULATION PUMPS TRIPPED	TROUBLESHOOTING WRONG TERMINAL STOP
G	BF1	027682*	112679	K	PM	D03	V	2	N	D			BOTH RECIRC MG SETS SHUTDOWN DURING NORMAL OP.	PERSONNEL TESTING WRONG RELAYS
G	BF2	010491	081174	H	PT	B02	U	1	T	T			HPCI ISOLATION OCCURED DURING MANUAL HPCI START	EXHST RUPTURE DISK FLD-SOL VLV WIRED WRNG
G	BF2	021782	062778	H	PT	D03	C	1	T	D			DAMAGE SUBSTAINED TO HPCI PUMP AND REDUCTION GEARS	VALVE IN LUBE OIL LINE WAS NOT OPENED
G	BR2	013343	041475	H	PT	B02	U	1	T	D			HPCI TURBINE STOP VALVE V8 FAILED TO OPEN FULLY	PERSONNEL ERROR-NEEDLE VLVS IMPRPR ADJST
G	BR2	014947*	052776	K	PM	D01	N	2	T	D			RECIRC PUMPS TRIPPD ON LOW L.O. PRESS	OPERATOR DID NOT FOLLOW EMERGNCY PROCEDRE
G	BR2	016260	110276	Q	PT	B02	U	1	N	D			RCIC TURBINE TRIPPD ON HI EXHAUST PRESS	EXHAUST STOP-CHECK VLV NOT OPENED
G	BR2	018134	050777	Q	PT	B01	U	1	N	D			RCIC TURB. OVERSPED AFTR MANUAL START FOLLWG SCRAM	OPERATOR DIDN'T CHECK MAN. SPEED SETTING
G	BR2	018676	062277	L	PM	B01	U	1	T	D			RHR 2A CHARGN MOTOR SWITCH IN OFF POSITION	PERSONEL LEFT SWITCH IN OFF POSITION
G	BR2	025639*	040479	R	PM	B13	U	2	T	T			RHR PUMPS 2B AND 2D WOULD NOT START FROM RTGB	POOR CONNECTIONS ON FUSES & FUSE BOX
G	BR2	032454A	090780	Q	PT	D01	U	1	T	D			RCIC TURBINE TRIPPED ON HIGH EXHUST PRESSURE	INCORRECT VALVE LINE-UP
G	BR2	0324548	090780	H	PT	U01	U	1	T	D			HPCI STOP-CHECK ALSO FOUND SHUT	PERSONNEL DIDNT VERIFY POSITN AFTER MAINT
G	DA1	010219	060474	Q	PT	B06	U	1	T	D			RCIC FAILED TO START AUTOMATICALLY	GOV CONT CKT SET HIGHER THAN OVRSPD TRIP
G	DA1	016588	122076	H	PT	B06	U	1	T	D			HPCI TURBINE TRIPPED ON FAST START WITH HI FLO IND	HI FLOW POIS SETPOINTS WERE INCORRECT

ALL COMMON CAUSE FAULTS

VEN	PLANT	CONTROL NUMBER	EVENT DATE	SYSTEM	COMP	MODE	CAUSE	TYPE	FAIL	NUM	ACTIVITY	CLASS	MODE DESCRIPTION	CAUSE DESCRIPTION
G	DA1	019127	092177	H	PT	C06	U	1			T	D	HPCI WOULD NOT DEVELOP SUFFCNT RPM	EXCESSIVE OPENING OF L.O. THROTLE VALVES
G	DR3	018549	080477	K	PM	C03	U	1			T	D	"A" RECIRC PUMP DID NOT RUNBACK DURIN FEED SYS TST	OPERATOR TURND OFF CONT.PWR TO "A" RECIRC
G	EN1	014789	042276	Q	PT	C02	U	1			T	D	RCIC TURBINE SPEED WOULD NOT INCREASE	PERSONNEL CUT CABLE TO PUMP (DUR OUTAGE)
G	EN2	022753	110678	H	PT	B02	U	1			T	D	HPCI PUMP FAILED TO QUICK START	WIRE ON CONTROL CIRCUIT NOT RECONNECTED
G	FP1	014488	032176	Q	PT	B03	U	1			T	D	BOTH EXHAUST RUPTURE DISKS RUPTURD DURIN FLOW TEST	MANUAL EXHAUST VALVE FULLY CLOSED
G	MO1	002172	073172	H	PT	B09	U	1			T	U	HPCI TURBINE TRIPPD ON OVERSPEED FOLLOWING MAINT.	PLASTIC FRAGMENTS FOUND IN OIL INLET PORT
G	MO1	002168	101172	U	PM	C06	U	1			T	D	STBY LIQ CONT PUMP DIDNT DEVELOP REQD HEAD	IMPROPER VENTING/FILL OF SUCTION LINE
G	NM1	017431	040477	R	PM	D06	U	1			N	U	WHILE LOWRNG R/X H2O LEVEL FOR MAINTNCE ON VESSEL	SHUTDWN COOLNG PMP TRPPD DUE TO LOW SUCT
G	OC1	002305*	080172	U	PM	B13	U	2			U	D	BRKR FOR 1 STBY LIQ CONT PUMP RACKED OUT-OTHER PMP	WOULD NOT START - AUX CONT PREVENTED OPE
G	OC1	013830*	121275	K	PM	D03	U	3			T	D	DEENERG 125V DC DIST CTR - LOSS OF 3 RECIRC PUMPS	PERSONNEL DID NOT FOLLOW PROCEDURES
G	OC1	0258258	050279	H	PM	B13	U	2			N	D	B&C FEED PUMPS DID NOT OPERATE AFTER SCRAM	BUS DE-ENERGIZED
G	OC1	027695	110379	D	PM	B03	U	1			T	D	CORE SPRAY BOOSTER PUMP DID NOT START, LOOSE FUSE	PERSONNEL MANIPULATING FUSE FOR TEST
G	PB2	020525	020778	H	PT	B02	U	1			T	D	TURBINE TRIPPD ON OVERSPEED; AUTO START TESTING	MISCALIBRATION OF TURBINE SPEED CONTROL
G	PB2	021081	042978	L	PM	U01	U	2			N	D	UNIT 2 "B","D"RHR BLOCKED FOR 2 HRS.	OPERTR REMVD UNIT 2 INSTED OF UNIT 3 PPPS
G	PI1	002247	100772	J	PM	D13	U	1			U	D	POWER CTR OVERCURRENT TRIP - LOSS OF CCW PUMP	LOADED PC SIMULTANEOUSLY VS SEQUENTIALLY
G	QC1	010516	072074	H	PT	C01	U	1			T	D	HPCI SPEED CHANGR MOTOR INOPER. CONT.POWR FUSES BL	SYS.IMPROPRLY TAKEN OUT OF SERVICE EARLER
G	QC1	016904	120276	L	PM	B02	U	1			U	D	AIR LOCKD SUCT HEADR COMMON TO 1A RHR LOOP,DIESL C	R4R SER WTR PMP HAD AIR LINE CONN TO CASE

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This report presents estimates of common cause fault rates and related quantities, based on Licensee Event Reports for pumps in nuclear reactors. The Licensee Event Report data base is described. For estimating rates, the binomial failure rate model is used, extended to allow for the substantial observed plant-to-plant variability, and for shocks that by their nature make all the pumps in a system inoperable. Every quantity is estimated by both a point estimate and a 90 percent interval. All rates are expressed per hour.

17. KEY WORDS AND DOCUMENT ANALYSIS

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Licensee Event Report (LER)
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