REACTOR CORE ISOLATION COOLING RELIABILITY ANALYSIS

RIVER BEND NUCLEAR STATION

by

RELIABILITY & PERFORMANCE ASSOCIATES

for

RELIABILITY SYSTEMS
ENGINEERING DEPARTMENT
RIVER BEND NUCLEAR GROUP

Prepared by: Bob Christie 9/10/91
Bob Christie
Reliability Consultant

Khoa Nguyen 9/10/91
Khoa Nguyen
Co-op Student

Reviewed by: A J Nguyen 9/10/91
A. J. "Zoom" Nguyen
Sr. Engineer

Approved by: O. A. "Skip" Holbert, Jr. 9/10/91
O. A. "Skip" Holbert, Jr.
Supervisor-Reliability Systems

TABLE OF CONTENTS

I. Introduction

In the United States today, nuclear power plant personnel are being asked to improve plant performance with limited budgets. This objective has led nuclear power plant personnel to focus their attention on equipment that has a high impact on power generation and public health risk. Power plant personnel are also trying to prevent equipment failure rather than repair equipment after failure.

In the maintenance area, a large amount of interest has been shown in recent years in the use of reliability engineering to help focus the attention of maintenance personnel on high impact equipment. The nuclear utility industry now has a small body of reliability engineers who have been working on Probabilistic Risk Assessments (PRA) of the nuclear units and are familiar with reliability engineering. River Bend personnel have been following the efforts in the United States to make use of reliability engineering in areas other than Probabilistic Risk Assessments to quantify public health risk. The techniques used in the PRA's are seen as tools to help River Bend personnel make better decisions. The effort documented in this report was motivated by the desire to measure the usefulness of reliability engineering techniques in the maintenance area. The results will be useful not only to maintenance personnel but also to operations and engineering personnel.

II. Objective and Summary

The objective of this analysis is to assist in the development of a maintenance strategy that will achieve and maintain an acceptable level for the conditional probability of the Reactor Core Isolation Cooling (RCIC) System starting and running for four hours given a valid demand.

The conditional probability for the RCIC system starting and running for four hours has ranged from 83% to 89% as seen in Figure 1.

The preventive maintenance tasks and the Surveillance Test Procedures which are presently being implemented for the RCIC system have been reviewed against the operating history of the components in the system and recommendations for change in these tasks are included in Sections VI and VII.

III. Definitions

Availability

The probability that a piece of equipment or a system will be operating during the time when it is desired to have the equipment or system operating.

Can also be stated at the ratio of the operating time to the total time (Up time - Total time).

Reliability

The probability that a piece of equipment or system will accomplish its mission over a specified period of time.

Standby Availability

The probability that a standby piece of equipment (not running during normal operation) will be in a condition where it is possible to start the equipment. For the RCIC system this will be the probability that the system is not in planned or forced maintenance during modes 1 and 2.

12 Month Sliding Average

Data for the parameter to be measured is taken for the last 12 month period and averaged over this 12 month period.

IV. RCIC Model

A. Background

The Reactor Core Isolation Cooling (RCIC) system is a standby system; i.e., it is not normally running during power operation. In fact, since it is not desirable to inject cold water into the reactor pressure vessel during operation, great care and attention are devoted to assuring that the system will not need to operate in the injection mode during the lifetime of the plant. The RCIC system is to be used to supply water to the reactor pressure vessel only during emergencies when the feedwater system cannot operate, the reactor pressure is high, and the reactor water level drops to a point where there is danger of reactor fuel damage.

The RCIC system is a single train system and, as such, most of the system must function to inject water into the reactor pressure vessel. There is little redundancy in the system. Some RCIC system equipment may be bypassed or ignored in the short term during injection (such as the gland seal subsystem), but all of the equipment along the entire path of steam from the reactor pressure vessel through the RCIC turbine to the suppression pool must function. Also, all of the equipment along the entire path of water from the condensate storage tank or suppression pool through the RCIC pump to the reactor pressure vessel must function. The RCIC model included all the equipment that would allow injection of water into the vessel.

The RCIC model was formulated upon the premise that no operator action would be allowed in the calculation of the probability of successful injection into the reactor pressure vessel. The model was based on a four-hour mission time. The four hours comes from the work done for the River Bend Station for the Station Blackout (loss of all AC power) sequence.

B. Phases

Following a valid demand signal the RCIC system must start and run. The model kept track of three phases of RCIC operating history.

1.) The RCIC system must be in a condition where it is possible to start the equipment (standby availability).

2.) The RCIC Main Steam Isolation Valve (E51*MOVF045) must open. The RCIC turbine and pump must start. Valve E51*MOVF013 must open. This was combined into probability of start.

3.) The RCIC system must run for 4 hours.

C. Standby Availability

The historical record of the RCIC system from January 1, 1988, through June 30, 1991, for operation in either modes 1 or 2 was analyzed to determine the times the RCIC system was in either planned or forced maintenance. The results are detailed in Table 1, Planned Maintenance Outages, and Table 2, Forced Maintenance Outages. Trending of the results is shown in Figures 2, 4, and 5.

The Standby Availability of the RCIC system ranges from 90% to 96% over the period covered (Figure 2). In 1988 and 1989 the amount of time spent in forced maintenance was larger than the time spent in planned maintenance. In 1990 and 1991 this has been reversed with more time now being spent in planned maintenance (Figure 4).

D. Probability of Start

Only "fast starts" were considered in the model. These are starts where valve E51*MOVF045 was closed when the signal to start was received. "Slow starts," where E51*MOVC002 is closed instead of E51*MOVF045, were not included in the calculations.

From January 1, 1988, to June 30, 1991, there have been 38 "starts" of the system (Table 3). All but one of these starts have been during surveillance testing. The only non-test start of the system occurred on November 13, 1989, when a dc-power-bus was lost. The RCIC system was isolated due to the bus failure. When power to the bus was restored, the RCIC system received an injection signal and the turbine/pump started, but was quickly stopped by the control operating foreman (COF) before any condensate storage tank water could be injected.

Of the 38 starts, 35 were successful. There were three occasions when the RCIC turbine tripped because of over-speed; December 11, 1988, January 3, 1990, and December 2, 1990. Figure 3 shows the trend in probability of start.

E. Probability of Run

Approximately 17 hours of run time were accumulated during the successful starts of the RCIC system. A generic failure to run value of 4×10^{-4}/hour for the RCIC pump/turbine was used and updated with zero failures in 17 hours and the value stayed essentially at 4×10^{-4}/hour. Failure rates of motor operated valves, check valves, and other valves are

much lower than the pump/turbine failure rates and were not included in the calculation. Using 4×10^{-4}/hour failure rate and a four hour mission time the probability of run was:

$$\text{Probability} = e^{-} = e^{-(4 \times 10^{-4})(4)}$$

$$= e^{-(1.6 \times 10^{-3})}$$

$$= 0.998$$

F. Conditional Probability

The probabilities from the three phases were multiplied together and trended in Figure 1. The conditional probability ranges from 83% to 89%.

V. Critical Equipment

A. Identification

An examination of the operating history of the RCIC system as detailed in Tables 1, 2, and 3 indicates a wide variety of problems in the system. As indicated in Section IV, most of the RCIC equipment must function correctly for success since the RCIC system is a single train system with little redundancy. The major trouble area appears to be the pump/turbine and the controls for the pump/turbine.

The mission for the pump/turbine as presently configured is an especially difficult one. The controls are programmed to open E51*MOVF045 (main steam isolation valve) immediately after a valid signal to start is received and use E51*MOVC002 (trip and throttle valve) and E51*HYVC002 (governor valve) to control the turbine. Water is kept solid through the pump in order that the RCIC pump will be drawing suction on water as soon as the turbine powers the pump. Small perturbations or malfunctions in the first minute following a start signal can result in system failure. This has been true in the three overspeed trip events.

B. Trends

In 1988 and 1989 a number of RCIC system isolations occurred during the performance of surveillance tests (Table 2). There have been no similar instances in 1990 and 1991. These isolations were not a big contributor to any decrease in standby availability because they were always of short duration.

There have been a few repairs on air operated valves 7/9/88, E51*AOVF026; 1/25/89, E51*AOVF26; and 11/15/89, E51*AOV54, but no pattern is evident.

The only recurring failure which is still causing a significant amount of forced maintenance is the problem with turbine overspeed trips.

VI. Periodic Maintenance

1.) Equipment ID: 1E51*TC002

Maintenance Task 1336, ME 03074

Frequency: Every 13 weeks

Clean and lubricate all external governor and controls linkage. Check governor valve stroke. Verify proper spring tensions.

Observation

Keep task. Addresses an important failure mode of the turbine.

2.) Equipment ID: 1E51*TC002

Maintenance Task 0336, ME 03192

Frequency: Every 3 months

Take lubricating oil samples after quarterly run of STP-209-3302.

Observation

The lube oil system has not been a significant problem area. Recommend deleting this task. Maintenance task ME 01549 changes the oil in the turbine during refueling. Maintenance task ME 03495 adds oil to the turbine as necessary. Deletion of ME 03192 will eliminate the requirement to perform a "slow start" and a "quick start" per SOP-0035 after the oil sample has been taken.

3.) Equipment ID: 1E51*TC002

Maintenance Task 123697, ME 03495

Frequency: As needed

Add oil as needed and investigate the reason for turbine being low on oil.

Observation

Keep task. Nuclear equipment operators are checking oil levels twice a day. Task allows maintenance crews to add oil when necessary.

4.) Equipment ID: 1E51*TC002

Maintenance Task 3688, ME 01549

Frequency: During refueling

Observation

Frequency of task is 999 (during refueling), but task description says "change oil in turbine per GMP-0015 every 52 weeks." The "... every 52 weeks" should be deleted.

The task description includes an instruction to use the "slow start" section of STP-209-3302 for retest. This is important in order to prevent turbine overspeed from any air introduced into the lube oil system during the oil change.

5.) Equipment ID: 1E51*TC002

Maintenance Task 27, ME 03174

Frequency: During refueling

Inspect the right angle drive gear assembly.

Observation

Keep task. Based on General Electric service letter. Also licensing commitment 08264.

6.) Equipment ID: 1E51*TC002

Maintenance Task 2761, MQ 00298

Frequency: On or before the third refueling outage since last performed.

Internal inspection of complete turbine assembly.

Observation

This task satisfies the requirements of EQMSR No. 221.452-1.

Recommend that this task be moved to every six refueling. Turbine is running approximately 5 to 10 hours per calendar year. Present frequency means complete inspection after approximately 40 hours of run time. A complete inspection after 80 hours of run time is still probably excessive.

7.) Equipment ID: 1E51*T002

Maintenance Task 38, ME 01548

Frequency: Every 260 weeks

Observation:

Recommend performing this task 1) after completion of task 2761, MQ 00298 and 2) midway between tasks 2761. That is, if task 2761 is moved to every 6th refueling, retorque all accessible turbine bolts and nuts every 3rd refueling.

8.) Equipment ID: 1E51*MOVC002

Maintenance Task 13272936, EL 01989

Frequency: Every 78 weeks

Perform preventive maintenance in accordance with PMP-1205.

Observation

Change frequency to during refueling. Routine valve maintenance during refueling is believed appropriate.

9.) Equipment ID: 1E51*HYVC002

Maintenance Task 13273989, ME 01552

Frequency: During refueling

Perform inspection of turbine governor valve internals.

Observation

Troubles with the governor valve have occurred at River Bend. However, the complete disassembly, inspection, and reassembly of the governor valve during every refueling is probably excessive. Recommend moving to every second or third refueling unless problems with the governor valve start to appear with a greater frequency than in the past.

10.) Equipment ID: 1E51*VF040

Maintenance Task 27, ME 02748

Frequency: During refueling

Disassemble, inspect, rework, reassemble.

Observation

There have been some problems with this check valve especially back in 1986. No forced outage maintenance on valve in 1988, 1989, 1990, 1991. Recommend moving frequency to every second or third refueling.

11.) Equipment ID: 1E51*EC002

Maintenance Task 1327, ME 01547

Frequency: During refueling

Disassemble, clean, inspect, reassemble heat exchanger.

Observation

Problems with the lube oil system did not show up as being significant. Recommend moving frequency to every second or third refueling.

12.) Equipment ID: 1E51*PC001

Maintenance Task 123697, ME 03363

Frequency: As needed

Add oil. Investigate reason for low oil in pump.

Observation

Keep task.

13.) Equipment ID: 1E51*PC001

Maintenance Task 123688, ME 01557

Frequency: Every 52 weeks

Change oil in pump bearings.

Observation

Recommend moving frequency to during refueling. Pump only running about 5-10 hours per calendar year.

14.) Equipment ID: 1E51*PC001

Maintenance Task 3688, ME 01556

Frequency: Every 52 weeks

Lubricate coupling per GMP-0015

Observation

Recommend moving frequency to during refueling.

15.) Equipment ID: 1E51*PC001

Maintenance Task 276061, ME03539

Frequency: Every 520 weeks

Disassemble, inspect, reassemble pump.

Observation

Checking the pump about every 10 years seems reasonable. Should be done during the closest refueling to the 10 year frequency.

16.) Equipment ID: 1E51*PC003

Maintenance Task 123697, ME 03361

Frequency: As needed

Add oil. Investigate cause of low oil level.

Observation

Keep task.

17.) Equipment ID: 1E51*PMC003

Maintenance Task 3638, EQ 02958

Frequency: Every 24 weeks

Lubricate (re-grease) motor bearings.

Observation

Task satisfies requirements of EQMSR 237.160-1 Rev. C Regreasing is conditional on grease sample.

18.) Equipment ID: 1E51*PC003

Maintenance Task 36, ME 01554

Frequency: Every 26 weeks

Change oil and lubricate pump bearings.

Observation

Recommend moving frequency to once per year, and combine with Task 3688, ME 01555, #19 below.

19.) Equipment ID: 1E51*PC003

Maintenance Task 3688, ME 01555

Frequency: Every 52 weeks

Lubricate coupling per GMP-0015 and manual.

Observation

Keep frequency, and combine with maintenance task 36, ME 01554, #18 above.

20.) Equipment ID: 1E51*PC003

Maintenance Task 5861, MQ 00254

Frequency: During refueling

Replace oil seal-coupling end, oil seal-in board end, o-ring-bearing housing, and o-ring-impeller.

Observation

Recommend moving to every other refueling due to lack of problems.

21.) Equipment ID: 1E51*PMC003

Maintenance Task 272978, EL 01990

Frequency: Every 104 weeks

Perform preventive maintenance per PMP-1065.

Observation

Keep task. Two year PM on motor is believed appropriate.

22.) Equipment ID: 1E51*PMC003

Maintenance Task 123649, EQ 01262
Maintenance Task 245861, EQ 02962

Frequency: EQ 01262 - Every 572 weeks
EQ 02962 - Every 577 weeks

Replace motor bearings.

Observation

Both tasks are doing the same thing. Delete one. Probably should delete EQ 01262 since EQ 02962 appears to have more information.

23.) Equipment ID: 1E51*C002

Maintenance Task 36, ME 01546

Frequency: During refueling

Change oil in compressor.

Observation

Keep task.

24.) Equipment ID: 1E51*C002

Maintenance Task 3681, ME 01545

Frequency: During refueling

Lubricate coupling.

Observation

Keep task.

25.) Equipment ID: 1E51*C002

Maintenance Task 1327, ME 01544

Frequency: During refueling

Inspect and clean suction and exhaust filters.

Observation

Keep task.

26.) Equipment ID Maintenance Task

1E51*MOVF010	13272936	EL 01991
1E51*MOVF019	13272936	EL 01993
1E51*MOVF022	13272936	EL 01994
1E51*MOVF045	13272936	EL 01996
1E51*MOVF046	13272936	EL 01997
1E51*MOVF059	13272936	EL 01998
1E51*MOVF068	13272936	EL 02001
1E51*MOVF077	13272936	EL 02003
1E51*MOVF078	13272936	EL 02004

Frequency: Every 78 weeks

Perform preventive maintenance in accordance with PMP-1205.

Observation

Move frequency to during refueling.

27.) Equipment ID Maintenance Task

1E51*MOVF013	13272936	EL 01992
1E51*MOVF031	13272936	EL 01995
1E51*MOVF063	13272936	EL 01999
1E51*MOVF064	13272936	EL 02000
1E51*MOVF076	13272936	EL 02002

Frequency: During refueling

Perform preventive maintenance in accordance with PMP-1205.

Observation

Keep task.

28.) Equipment ID Maintenance Task Frequency

1E51*MOVF013	2461	EQ 02739	Every 351 months
1E51*MOVF031	2461	EQ 02740	Every 454 months
1E51*MOVF059	2461	EQ 02741	Every 351 months
1E51*MOVF064	2461	EQ 02800	Every 438 months

Replace o-rings and seals.

Observation

Keep task. EQ requirement.

29.) Equipment ID: 151*MOVF064

Maintenance Task 24619799, EQ 02756

Frequency: Every 788 weeks

Replace o-rings and seals.

Observation

Keep task. EQ requirement.

30.) Equipment ID: 1E51*MOVF064

Maintenance Task 246197, EQ 02778

Frequency: Every 234 months

Replace the motor.

Observation

Keep task. EQ requirement.

31.)

Equipment ID	Maintenance Task		Frequency
1E51*AOVF004	245861	EQ 02919	Undetermined
1E51*AOVF005	245861	EQ 02920	Every 243 months
1E51*AOVF025	245861	EQ 02921	Undetermined
1E51*AOVF026	245861	EQ 02922	Undetermined
1E51*AOVF054	245861	EQ 02923	Undetermined

Replace subcomponents that have reached the end of their qualified life.

Observation

Keep task. EQ requirement.

32.) Equipment ID: 1E51-K603

Maintenance Task 101327, EL 15135
Frequency: During refueling

Clean and perform a functional check on Topaz inverter 1E51-K603 panel.

Observation

On 2/11/90 Topaz inverters to H13-P618 and H13-P652 failed.

VII. Surveillance Test Procedures

A. Observations - General

Identified 61 surveillance test procedures associated with the RCIC system. Six of these are concerned with the operability of the system. The vast majority (50 out of 61) are calibration checks of sensors.

There are only three surveillance test procedures that have a significant impact on assuring that the RCIC system will work given a valid demand signal.

STP-209-0201 Checks certain valve positions once a month.

STP-209-3301 Checks valve movement on certain valves once a quarter.

STP-209-3302 System flow test; condensate storage tank back to condensate storage tank once a quarter.

The RCIC pump and turbine are rarely checked in a manner similar to the demand that the system might see in the rare event that a valid demand was generated by abnormal conditions in the plant. The normal pattern is to schedule a RCIC system outage toward the end of a quarter, isolate the RCIC system for the outage, perform preventative maintenance tasks and corrective maintenance tasks during the outage, run the necessary surveillances at the end of the maintenance outage and then put the RCIC system back in standby. The time that the pump and turbine are operated averages about 30 minutes for STP-209-3302.

A better pattern would be to run a "slow start" of the pump/turbine just prior to the maintenance outage. Such a slow start woud allow one to check for degraded conditions in the system since the last pump/turbine run. Then one could isolate the system, perform maintenance, perform the applicable STP's, and put the system back into standby. At least once a year, the pump/turbine should be run for approximately four hours. It is recognized that the longer run would add more reactor coolant water to the suppression pool with the attendant increased problems with radiation and heat removal.

A network of sensors has been superimposed on the RCIC system. These sensors are designed to isolate the system given certain abnormal events. Due to the large number of sensors, there are a large number of calibration checks of these sensors (STP's). In most cases these calibration checks do not have a direct impact on the RCIC system

availability. However, the overall impact of these RCIC STP's has been negative.

Isolations have occurred while performing these calibration checks. Isolations have been mandated when the sensors fail and the sensors have to be repaired. There is a trade off that must be made in order to keep the conditional probability of RCIC working high while at the same time making provisions for piping failures in the RCIC system.

One way to handle this trade off (and the recommended one) is to eliminate the isolation of RCIC given the actuation of the sensors superimposed on the RCIC system. The decision to isolate the RCIC system should be left to the operating crew for signals such as high ambient temperature in the RCIC equipment room. This would be very tough to implement because it would mean a change in the tech specs. It would require deletion of

Table 3.3.2-1.5
Table 3.3.2-2.5
Table 3.3.2-3.5
Table 4.3.2.1-1.5

from the technical specifications. However, if implemented, the change would have a positive impact on the conditional probability of the RCIC system working given a valid demand. This must be considered a long-term recommendation.

An interim recommendation would be to move the frequency of certain surveillances to the values given in Table 4. Table 4 frequency changes are based on the adjustment history of the surveillances as given in Table 5.

B. Observations - Specific

1.) Most of the surveillance test procedures are calibration checks of sensors. In most cases these calibration checks allow two hours of the system being "inoperable" before a formal LCO is filed. However, some of the STP's allow only one hour. The ones allowing one hour are

STP-207-4243	RCIC Isolation - RCIC Equipment Room Differential Temperature - High.
STP-207-4248	RCIC, RHR Isolation - Steam Line Flow - High.
STP-207-4249	RCIC, RHR Isolation - Steam Line Flow - High.
STP-207-4537	RCIC Isolation - Steam Line Flow - High.
STP-207-4549	RCIC, RHR Isolation Steam Line Flow - High.
STP-207-5252	RCIC, RHR Isolation - RHR Equipment Area Ambient Temperature - High.

A decision should be made as to how many hours the specs allow. Recommend 2 hours.

2.) STP-209-4209 & STP-209-4210	Main Steam Line Tunnel - Temperature. Timer Quarterly Channel Calibration.

In 1986 a modification was initiated to eliminate the timers from the logic (MR-86-0539). Work was completed on the Modification, 10/25/86, but the timer was not eliminated from the logic. Modification must made it easier to test the timer which has a zero (0) second time delay.

Commitment 05258 still exists. This commitment indicates the timers will be eliminated and when they are, the STP's will be deleted.

Recommend discontinuation of the STP's. As indicated in the general comments, having sensors which isolate the RCIC system is damaging to the conditional probability of the RCIC system working when needed.

Recommend deletion of Tech Spec

Table 3.3.2-1.5 g,h,i
Table 3.3.2 2 5 g,h,i
Table 4.3.2.1-1 5 g,h,i

C. Intersystem Leakage

STP-209-4211 Reactor Coolant System Interface Valve
Revision 5 Leakage Pressure Monitor
Monthly Channel Functional
18-month Channel Calibration checks for leakage past E51*AOVF065, E51*AOVF066, and E51*MOVF013.

Doesn't appear to impact RCIC system availability.
No Valve Movement.

D. System Operability Checks

1.) STP-209-0201 Revision 3 — RCIC Discharge Piping Fill and Valve Lineup Verification.

Once a month checks position of following key valves.

1E51*MOVC002	1E51*MOVF045	1E51*MOVF068
1E51*HYVC002	1E51*MOVF046	1E51*MOVF076
1E51*MOVF010	1E51*MOVF059	1E51*MOVF077
1E51*MOVF013	1E51*MOVF063	1E51*MOVF078
1E51*MOVF019	1E51*MOVF064	1E51*VF060
1E51*MOVF022	1E51*MOVF065	1E51*VF062
1E51*MOVF031	1E51*MOVF066	

Doesn't have direct impact on RCIC system availability. No valve movement.

2.) STP-209-0601 Revision 4B — RCIC Initiation Functional

Checks initiation logic, both manual and automatic.

Done at least once per 18 months with steam dome pressure greater than 150 psig.

The RCIC system will be unavailable during this test because the injection valve (1E51*MOVF013) breaker is open.

The RCIC pump will transfer water from the condensate storage tank to the suppression pool during this procedure.

The following valves are checked for correct operation during this procedure.

1E51*MOVC002	1E51*MOVF046	1E51*AOVF025
1E51*MOVF013	1E51*MOVF059	1E51*AOVF026
1E51*MOVF019	1E51*HYVC002	
1E51*MOVF022	1E51*AOVF004	
1E51*MOVF045	1E51*AOVF005	

3.) STP-209-0602 Revision 4 — RCIC System Flow Test

Checks system flow when reactor pressure is 150 psig. Low end of pressure spectrum.

Done at least once per 18 months within 12 hours after reactor steam pressure is greater than or equal to 150 psig.

The only impact on RCIC availability might come if valid signal came in during test and some flow was diverted to CST before closing test valves.

The following valves are checked for correct operation during this procedure

1E51*MOVC002	1E51*MOVF059	1E51*VF011
1E51*MOVF019	1E51*AOVF004	1ICS*V021
1E51*MOVF022	1E51*AOVF005	
1E51*MOVF045	1E51*AOVF025	
1E51*MOVF046	1E51*AOVF026	

4.) STP-209-3302 RCIC Pump Operability and Flow Test.
Revision 6

Quarterly test. Checks system flow when reactor pressure is 1020 psig. Checks movement of check valves.

The only impact on RCIC availability might come if valid signal came in during test and some flow was diverted to CST before closing test valves.

The following valves are checked for correct operation during this test.

1E51*MOVC002	1E51*AOVF004	1E51*VF011
1E51*MOVF019	1E51*AOVF005	1E51*VF040
1E51*MOVF022	1E51*AOVF025	1E51*VF061
1E51*MOVF045	1E51*AOVF026	1ICS*V21
1E51*MOVF046		
1E51*MOVF059		

5.) STP-209-3301 RCIC Valve Operability
Revision 5A

Checks valve movement for certain valves on a quarterly basis to verify isolation times are within limits and valves are in correct positions. Some valves are checked during cold shutdown because checking during power operation would hinder normal operation.

The only impact on RCIC availability might come if valid signal in while a valve was being moved. The actual accident signal would have to override the local valve movement. This is believed to have a very small impact on RCIC availability.

The following valves are checked for correct operation during this test.

1E51*MOVC002	1E51*MOVF063	1E51*VF079
1E51*MOVF010	1E51*MOVF064	1E51*VF081
1E51*MOVF013	1E51*MOVF068	1E51*AOVF004
1E51*MOVF019	1E51*MOVF076	1E51*AOVF005
1E51*MOVF022	1E51*MOVF077	1E51*AOVF025
1E51*MOVF031	1E51*MOVF078	1E51*AOVF026
1E51*MOVF045	1E51*VF011	1E51*AOVF065
1E51*MOVF046	1E51*VF040	1E51*AOVF066
1E51*MOVF059	1E51*VF061	

6.) STP-000-3607 Revision 0A — Check Valves Tested per ASME XI, Inservice Testing by Disassembly

Checks operation of 1E51*VF030 by disassembly during refueling. Valve 1E51*VF030 (suction from suppression pool for RCIC pump) is not checked during any of the system flow tests. This procedure disassembles and then reassembles the valve in order to assure check valve movement. Indirect test only.

Test has no direct impact on RCIC system availability.

E. Remote Shutdown Capability - Calibration Checks

1.) STP-209-4210 RSS/RCIC System Flow, 18-month Channel
Revision 5A Calibration

Calibrates the instruments used to control RCIC flow when using the remote shutdown facility.

Doesn't have a direct impact on RCIC system availability. If a valid RCIC system start signal was generated during this test RCIC would start and run. Operation personnel would have to control RCIC flow from the remote shutdown area rather than from the main control room.

2.) STP-209-5211 RSS/RCIC Turbine Speed
Revision 3A 18-month Channel Calibration

Calibrates the instrument used to control RCIC turbine speed when using the remote shutdown facility.

Doesn't have a direct impact on RCIC system availability. If a valid RCIC system start signal was generated during this test, RCIC would start and run. Operation personnel would have to control RCIC turbine speed from the remote shutdown area rather than from the main control room.

F. Pump Suction Switchover - Calibration Checks

1.) STP-209-4204 Revision 5 — RCIC Actuation - Condensate Storage Tank Water Level - Low. Monthly Channel Functional, 18-month CHCAL, 18-month LSFT

Checks and calibrates the instrumentation used to switch RCIC pump suction from condensate storage tank to suppression pool when the CST water level reaches the low level setpoint.

Doesn't directly impact RCIC system availability. During a portion of this test 1E51*MOVF010 will be closed and 1E51*MOVF031 will be opened. If a valid RCIC start signal was generated during this time, the RCIC pump would draw suction on the suppression pool rather than on the CST.

2.) STP-209-4205 Revision 5 — RCIC Actuation - Condensate Storage Tank Water Level - Low. Monthly CHFunct, 18-month Cal, 18-month LSPT

3.) STP-209-4206 Revision 7A — RCIC - Suppression Pool Water Level - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT

4.) STP-209-4207 Revision 5 — RCIC - Suppression Pool Water Level - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT

Same comments apply F.2., F.3., and F.4. as F.1.). No direct impact on RCIC system availability.

F. Pump Suction Switchover - Calibration Checks

1.) STP-209-4204 Revision 5 — RCIC Actuation - Condensate Storage Tank Water Level - Low. Monthly Channel Functional, 18-month CHCAL, 18-month LSFT

Checks and calibrates the instrumentation used to switch RCIC pump suction from condensate storage tank to suppression pool when the CST water level reaches the low level setpoint.

Doesn't directly impact RCIC system availability. During a portion of this test 1E51*MOVF010 will be closed and 1E51*MOVF031 will be opened. If a valid RCIC start signal was generated during this time, the RCIC pump would draw suction on the suppression pool rather than on the CST.

2.) STP-209-4205 Revision 5 — RCIC Actuation - Condensate Storage Tank Water Level - Low. Monthly CHFunct, 18-month Cal, 18-month LSPT

3.) STP-209-4206 Revision 7A — RCIC - Suppression Pool Water Level - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT

4.) STP-209-4207 Revision 5 — RCIC - Suppression Pool Water Level - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT

Same comments apply F.2., F.3., and F.4. as F.1.). No direct impact on RCIC system availability.

G. RCIC Pump/Turbine Self Protection - Calibration Checks

1.) STP-207-4811 Revision 5 — RCIC Isolation - RCIC Steam Line Flow - High. 18-month response time test

Closes 1E51*MOVF064 for test.

2.) STP-207-4812 Revision 5 — RCIC Isolation - RCIC Steam Line Flow - High. 18-month response time test.

Closes 1E51*MOVF063 for test.

Both of these tests make the RCIC system unavailable because the steam supply to the RCIC turbine is closed off. Testing is normally done just before going into refueling.

3.) STP-207-4538 Revision 3 — RCIC Isolation - RCIC Steam Supply Pressure - Low. Monthly CHFunct.

4.) STP-207-4539 Revision 1 — RCIC Isolation - RCIC Steam Supply Pressure - Low. Monthly CHFunct.

5.) STP-207-4238 Revision 5 — RCIC Isolation - RCIC Steam Supply Pressure - Low. 18-month CHFunct and 18-month LSFT.

6.) STP-207-4239 Revision 5 — RCIC Isolation - RCIC Steam Supply Pressure - Low. 18-month CHFunct and 18-month LSFT.

7.) STP-207-4813 Revision 5A — RCIC Isolation - RCIC Steam Supply Pressure - Low. 18-month response time, Channel A.

8.) STP-207-4814 Revision 4A — RCIC isolation - RCIC Steam Supply Pressure - Low. 18-month response time, Channel B.

9.) STP-207-4294 Revision 5 — RCIC Isolation - RCIC Steam Line Flow - High. Timer Quarterly CHCAL.

10.) STP-207-4295 Revision 5 — RCIC Isolation - RCIC Steam Line Flow - High. Timer Quarterly CHCAL.

11.) STP-207-4536 Revision 1 — RCIC Isolation - RCIC Steam Line Flow - High. Monthly CHFunct.

12.) STP-207-4537 Revision 2A — RCIC Isolation - RCIC Steam Line Flow - High. Monthly CHFunct.

13.) STP-207-4236 Revision 7 — RCIC Isolation - RCIC Steam Line Flow - High. 18 - month CHCAL and 18-month LSFT.

14.) STP-207-4237 Revision 6A — RCIC Isolation - RCIC Steam Line Flow - High. 18-month CHCAL and 18-month LSFT.

15.) STP-207-4548 Revision 3 — RCIC, RHR Isolation - RCIC Steam Line Flow - High. Monthly CHFunct.

16.) STP-207-4549 Revision 1 — RCIC, RHR Isolation - RCIC Steam Line Flow - High. Monthly CHFunct.

17.) STP-207-4248 Revision 8 — RCIC, RHR Isolation - RCIC Steam Line Flow - High. 18-month CHCAL and 18-month LSFT.

18.) STP-207-4249 Revision 5A — RCIC, RHR Isolation - RCIC Steam Line Flow - High. 18-month CHCAL and 18-month LSFT.

19.) STP-209-4201 Revision 6 — RCIC Isolation - RCIC Turbine Exhaust Diaphragm Pressure - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT.

20.) STP-209-4202 Revision 7 — RCIC Isolation - RCIC Turbine Exhaust Diaphragm Pressure - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT

21.) STP-209-5201 Revision 7 — RCIC Isolation - RCIC Turbine Exhaust Diaphragm Pressure - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT

22.) STP-209-5202 Revision 6 — RCIC Isolation - RCIC Turbine Exhaust Diaphragm Pressure - High. Monthly CHFunct, 18-month CHCAL 18-month LSFT.

The 20 surveillances listed above (E.3. through E.22.) do not directly impact RCIC system availability. They also do not cause any valve movement in the RCIC system.

H. RCIC Pipe Leakage/Rupture Protection - Calibration Checks

1.) STP-207-4240 Revision 6B — RCIC Isolation - RCIC Equipment Room Ambient Temperature - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT

The monthly CHFunct and the 18-month LSFT have no direct impact on RCIC system availability. The 18-month CHCAL opens the circuit breakers for 1E51*MOVF064 and 1E51*MOVF031. This does not directly impact RCIC system availability because 1E51*MOVF064 is normally open and will stay open when the circuit breaker is opened. 1E51*MOVF031 is normally closed and cannot be opened until the circuit breaker is racked back in. Therefore, the RCIC pump cannot take suction from the suppression pool while the breaker is open. The normal RCIC pump suction is from the condensate storage tank; the suppression pool is backup. Also get movement of 1E51*MOVFC002 during 18-month CHCAL.

2.) STP-207-4241 Revision 7 — RCIC Isolation - RCIC Equipment Room Ambient Temperature - High. Monthly CHFunct, 18-month LSFT.

The monthly CHFunct and the 18-month LSFT have no direct impact on RCIC system availability. The 18-month CHCAL opens the circuit breakers for 1E51*MOVF063 and 1E51*MOVF076. This does not directly impact RCIC system availability because 1E51*MOVF063 is normally open and will stay open when the circuit breaker is racked out. 1E51*MOVF076 is normally closed and will stay closed. 1E51*MOVF076 is not necessary for RCIC operation. It is the bypass line valve around 1E51*MOVF063 and used to warm up the RCIC steam supply line if 1E51*MOVF063 had been closed. Also get movement of 1E51*MOVC002 during 18-month CHCAL.

3.) STP-207-4242 Revision 6A — RCIC Isolation - RCIC Equipment Room Differential Temperature - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT.

4.) STP-207-4243 Revision 7A — RCIC Isolation - RCIC Equipment Room Differential Temperature - High. Monthly CHFunct, 18-month CHCAL 18-month LSFT.

5.) STP-207-5252 Revision 7A — RCIC, RHR Isolation - RHR Equipment Area Ambient Temperature - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT.

6.)	STP-207-5253 Revision 7	RCIC, RHR Isolation - RHR Equipment Area Ambient Temperature - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT.
7.)	STP-207-5254 Revision 6	RCIC, RHR Isolation - RHR Equipment Area Ambient Temperature - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT.
8.)	STP-207-5255 Revision 5	RCIC, RHR Isolation - RHR Equipment Area Ambient Temperature - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT.
9.)	STP-207-5248 Revision 5	RCIC, RHR Isolation - RHR Equipment Area Differential Temperature - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT.
10.)	STP-207-5249 Revision 5	RCIC, RHR Isolation - RHR Equipment Area Differential Temperature - High. Monthly CHFunct, 18-month CHCAL 18-month LSFT.
11.)	STP-207-5250 Revision 3	RCIC, RHR Isolation - RHR Equipment Area Differen-tial Temperature - High. Monthly CHFunct, 18-month CHCAL. 18-month LSFT.
12.)	STP-207-5251 Revision 3	RCIC, RHR Isolation - RHR Equipment Area Differential Temperature - High. Monthly CHFunct, 18-month CHCAL 18-month LSFT.
13.)	STP-207-4501 Revision 2	NSSS/RWCU/RCIC Isolation - Main Steam Line Tunnel Ambient Temperature - High. Monthly CHFunct.
14.)	STP-207-4502 Revision 2	NSSS/RWCU/RCIC Isolation - Main Steam Line Tunnel Ambient Temperature - High Monthly CHFunct.
15.)	STP-207-4209 Revision 5	MSL Tunnel Temperature Timer Quarterly CHCAL.
16.)	STP-207-4210 Revision 5	MSL Tunnel Temperature Timer Quarterly CHCAL.

17.)	STP-207-4201 Revision 7	NSSS/RWCU/RCIC Isolation - Main Steam Line Tunnel Ambient Temperature - High. 18-month CHCAL, 18-month LSFT.
18.)	STP-207-4202 Revision 8	NSSS/RWCU/RCIC Isolation - Main Steam Line Tunnel Ambient Temperature - High. 18-month CHCAL, 18-month LSFT.
19.)	STP-207-4205 Revision 7A	NSSS/RWCU/RCIC Isolation - Main Steam Line Tunnel Differential Temperature - High Monthly CHFunct, 18-month CHCAL, 18-month LSFT.
20.)	STP-207-4206 Revision 7	NSSS/RWCU/RCIC Isolation - Main Steam Line Tunnel Differential Temperature - High. Monthly CHFunct, 18-month CHCAL, 18-month LSFT.

I. Isolation Valve Tests

1.) STP-219-0603 RCIC Manual Isolation Functional Test
Revision 2

Performs a Channel Functional Test (CHFunct) and Logic System Functional Test (LSFT) of the RCIC manual isolation actuation.

Done during modes 4 or 5 only. Steam lines to RCIC turbine must be drained of all water. RCIC isolated.

The following valves change position during this test:

1E51*MOVC002	1E51*MOVF045	1E51*MOVF077
1E51*MOVF010	1E51*MOVF063	1E51*MOVF078
1E51*MOVF013	1E51*MOVF064	
1E51*MOVF031	1E51*MOVF076	

2.) STP-209-3603 RCIC Pressure Isolation Valve Leakage
Revision 3 Test

Leak test of 1E51*MOVF013 done during refueling.

No impact on RCIC system availability.

3.) STP-209-3807 Reactor head Spray Valve Leak Rate Test
Revision 3

Leak rate test of 1E51*AOVF066, 1E51*AOVF065, and 1E51*MOVF013 done during refueling.

No impact on RCIC system availability.

4.) STP-209-3818 RCIC Valve Leak Rate Test (Air)
Revision 2

Leak rate test of 1E51*MOVF063, 1E51*MOVF064, 1E51*MOVF068, 1E51MOVF076, 1E51*MOVF077, and 1E51*MOVF078 done during refueling.

No impact on RCIC system availability.

5.) STP-209-3834 RCIC Valve Leak Rate Test (Water)
Revision 3

Leak rate test of 1E51*MOVF019 and 1E51*MOVF013 done during refueling.

No impact on RCIC system availability.

J. ASME Section XI Relief Valve Testing

STP-000-3606 Section XI Safety and Relief Valve Testing
Revision 4A

Test set pressure of relief valve 1E51*RVF018. Not sure that 1E51*RVF017, 1E51*RVF090, and 1ICS*RV130 are covered.

No impact on RCIC system availability.

VIII. Recommendations

The most beneficial change that can be made to enhance the reliability of the RCIC system is to change the way the pump/turbine is started. The start should be a slow gradual admission of steam to the turbine and a slow, steady increase to full flow. The present start cycle results in the most probable failure mode being the overspeed trip of the turbine. This is one of the most damaging failure modes because in order to restore the RCIC turbine to service, an operator must be sent to the RCIC turbine room to manually reset the overspeed trip.

The justification for a slow start of RCIC is operating experience. Boiling Water Reactor plants rely on the feedwater system to provide water to the reactor vessel in both normal and abnormal events. This is the preferred method and the method actually used in the plants. It is only in highly unlikely events (which take time to develop) that the plants need emergency water supply.

It should be recognized that changing to a "slow start" of the RCIC system represents a major change. Changes in the technical specifications are involved. Approval from the NRC must be granted. This should be a "long term" recommendation.

One possible way to have a slow start might be to change the valving arrangement such that 1E51*MOVF045 is normally open and 1E51*MOVF063 and 1E51*MOVF064 are normally closed. Then a mechanism for slowing warming up the RCIC line from valves MOVF063 and MOVF064 to the turbine and for slowly opening valves 1E51*MOVF063 and 1E51*MOVF064 would have to be devised given a valid demand on RCIC.

By changing the normally closed valve from 1E51*MOVF045 back to 1E51*MOVF063 and 1E51*MOVF064, River Bend might gain the following advantages.

1.) Thermal efficiency of the reactor is improved.

2.) Radiation exposure in the auxiliary building is reduced.

3.) Potential for high energy pipe leak or break is reduced.

4.) Might be able to eliminate sensors which isolate RCIC given a RCIC steam line leak or break (e.g., steam tunnel temperature, RCIC equipment room temperature, etc.) because the RCIC steam line is now no longer a high energy line past the isolation valves. This would eliminate a large number of surveillance test procedures.

Other schemes to have a slow start of the RCIC turbine are also possible and should be investigated. The key will be to change to a start mechanism that will enhance the probability of the RCIC pump/turbine starting and running for 4 hours given a valid demand.

Other recommendations appear in Section VI and Section VII.

IX. References

1.) Control Room Log, January 1, 1988 through June 30, 1991.

2.) Clearances on RCIC system equipment, January 1, 1988 through June 30, 1991.

3.) Limiting Condition of Operation on RCIC system equipment, January 1, 1988 through June 30, 1991.

4.) Condition Reports on RCIC system equipment January 1, 1988 through June 30, 1991.

5.) Maintenance Work Orders on RCIC system equipment January 1, 1988 through June 30, 1991.

TABLE 1

RCIC MAINTENANCE OUTAGE

Maintenance Outages During Power Operation January 1, 1988, to June 30, 1991

3/1/88 - 23 hours

4/4/88 - 45 hours

6/14/88 - 9 hours

9/8/88 - 48 hours

12/5/88 - 34 hours

1/23/89 - 69 hours

3/5/89 - 53 hours

3/14/89 - 24 hours

9/26/89 - 37 hours

12/29/89 - 26 hours

4/23/90 - 25 hours

5/20/90 - 57 hours

7/16/90 - 74 hours

8/14/90 - 96 hours

9/13/90 - 24 hours

3/21/91 - 46 hours

6/19/91 - 30 hours

TABLE 1

RCIC MAINTENANCE OUTAGE

3/1/88 - 23 hours

1.) MWP514886 E51*TC002 ME 03074
Cleaned and lubricated all external linkages. No discrepancies noted.

2.) MWR119867 E51*TC002
Flange leak on casing. Torqued bolts. Still small amount of leakage.

TABLE 1

RCIC MAINTENANCE OUTAGE

4/4/88 - 45 hours

1.) MWP516289 E51*LSN037 IC 08461
Inspected switch. Found within calibration. Replaced o-ring.

2.) MWP516410 E51*LSN010 IC 08460
Inspected switch. Found within calibration. Replaced cover o-ring.

3.) MWP516737 E51*TC002 ME 03174
Inspected gears and bushings of turbine. No signs of abnormal wear.

4.) MWP516739 E51*C002 ME 01546
Changed oil on both bearings.

5.) MWP 516740 E51*C002 ME 01545
Lubricated coupling. Checked alignment.

6.) MWP516741 E51*C002 ME 01544
Inspected suction and discharge filters. Satisfactory.

7.) MWP516769 E51*PC003 ME 01554
Changed oil.

TABLE 1

RCIC MAINTENANCE OUTAGE

6/14/88 - 9 hours

1.) MWP518154 E51*TC002 ME 03074
Lubricated governor. Checked valve stroke and spring tension.

2.) MWR115801 E51*VF047
Frequent alarm on E51*LSN037 indicates restriction in line. Removed valve cover, inspected valve, found no problems, reassembled valve.

3.) MWR116813 E51*TC002
Small oil leak on west side of governor actuator. Disassembled tubing fitting. Reassembled using never seize compound.

TABLE 1

RCIC MAINTENANCE OUTAGE

9/8/88 - 48 hours

1.) MWP520929 E51*LSN010 IC 08460
Hooked up test rig for level switch. Checked level in chamber. Verified SOV for AOVF054 operator. Performed PM's.

2.) MWP520930 E51*LSN037 IC 08461
Calibrated level switch in accordance with MCP-4051. Had to mechanically agitate float chamber to get it to respond. Replaced gasket on switch cover.

3.) MWP520945 E51*TC002 ME 03192
Drew oil sample.

4.) MWP520946 E51*TC002 ME 03074
Cleaned and lubricated external linkage. All linkages appear to move freely. Governor valve stroke is 7/8". Verified proper spring tension.

5.) MWP521130 E51*PC003 ME01554
Changed oil.

6.) MWP521131 E51*PC003 ME 01555
Lubricated coupling per GMP-0015. Found no loose bolts or leaking seals.

7.) MWP521132 E51*TC002 ME 03174
Inspected gears, shaft bushings, thrust washer, angle drive assembly. No abnormal wear or indications of lack of lubricant. Sheared off dowel pin from bearing end cover during removal. MWR120014 written to fix.

8.) MWP521133 E51*C002 ME 01544
Inspected filters and muffler. Do not require cleaning or changing.

9.) MWP521134 E51*C002 ME 01545
Greased coupling. Checked alignment, found to be OK.

10.) MWP521150 E51*TC002
Sampled oil (ME 03192, Task 0334) and forwarded to chemistry. No discrepancies found.

11.) MWR112329 ICS-PI167
Removed broken guage on gland seal compressor. Installed and calibrated new guage.

TABLE 1

RCIC MAINTENANCE OUTAGE

9/8/88 - 48 hours (continued)

12.) MWR116799 ICS*V61
Packing blowing some steam. Tightened backing. No new packing needed.

13.) MWR117834 E51*V308
Valve rotates on line. Removed valve. Reinstalled with small amount of pipe dope on threads.

14.) MWR117874 E51*LSN037
Mounting plate base and switch assembly can rotate. Tighten set screws on base.

15.) MWR118184 E51*ROD004
Frequent alarm on E51*LSN037 indicates plugging of orifice. Checked line. No plugging. Suspect problem may be 1" check valve.

TABLE 1

RCIC MAINTENANCE OUTAGE

12/5/88 - 34 hours

1.) MWP523274 E51*TC002
Cancelled ME 01552.

2.) MWP523275 E51*TC002 ME 01557 (now ME 01549)
Drained oil from cooler and sump at rear of turbine. Changed oil and filters.

3.) MWP523354 E51*PC001 ME 01557
Drained oil from outboard and inboard bearings. Changed oil.

4.) MWP523355 E51*PC001 ME 01556
Grease coupling. All four 1/8" pipe plugs stuck. Broke coupling loose. MWR128050 written to drill out and replace 1/8" plugs.

5.) MWP523593 E51*TC002 ME 03074
Cleaned and lubricated linkage on governor valve.

6.) MWE518821 E51*AOVF025 IQ 00787
Replaced diaphragm.

7.) MWE522300 E51*PC003 EQ 02958
Lubricated motor bearings.

8.) MWE518900 E51*AOVF026 IQ 00788
Installed new diaphragm. Torqued bolts.

9.) MWP523767 E51*TC002 ME 03192
Took oil sample to chemistry.

10.) MWR129527 ICS*V58
Packing leak. Tightened packing gland follower nuts.

11.) MWR129528 ICS*V61
Packing leak. Tighten packing gland follower nuts.

TABLE 1

RCIC MAINTENANCE OUTAGE

1/23/89 - 69 hours

1.) MWP523893 E51*PC003 ME 01554
Changed oil.

2.) MWP524704 ILICS.025 IC 04660
Performed MCP4000 using LCR1ILICS.025 device calibration. Found lift off and stroke at 3 psi and 19 psi respectively. Adjusted bench set as required. All are now satisfactory. Cycled gov. as required with satisfactory results.

3.) MWP527267 E51*TC002 ME 03074
Checked and cleaned linkage and spring. No discrepancy noted.

4.) MWP527269 E51*TC002 ME 03192
Took oil sample.

5.) MWP527270 E51*C002 ME 01544
Checked muffler, checked intake & exhaust filters, satisfactory. No discrepancies noted.

6.) MWP527271 E51*C002 ME 01545
Lubed coupling. Checked coupling alignment. Satisfactory. Took oil sample and delivered to chemistry.

7.) MWP527272 E51*C002 ME 01546
Changed oil.

8.) MWP527365 E51*C002 EL 01988
Performed PMP-1067 and GMP-0015. All data was acceptable. Cleaned motor. No loose connections. Meggered motor. Took vibration and running current readings. All readings were acceptable. No lubrication was necessary per GMP-0015.

9.) MWE526338 E51*LSN037 IQ 00178
Attempted to check calibration. Switch was found in the open position (de ener). Filled top of switch chamber to overflowing into drain pot, but switch never changed state. Wrote MWR110966 to investigate.

Flushed the switch several times. Got switch to actuate. The reset valve was out of tolerance and MCP-4051 does not allow this adjustment. Generated MWO110969 to investigate/recalibrate as necessary. Generated MWO110967 to replace the flex conduit on the switch. Performed MCP4051.

TABLE 1

RCIC MAINTENANCE OUTAGE

1/23/89 - 69 hours (continued)

10.) MWE526436 E51*LSN010 IQ 00177
Set up test equipment. Had difficulty getting switch to actuate. Ran level up and down several times, switch began to work. Trip and reset valves were within tolerances. Replaced the O-ring. Generated MWO110968 to replace the flex conduit on the switch. Performed MCP4051.

11.) MWR128414 DTM*V58
RCIC steam supply drain pot line drain has leak. Replaced packing rings.

12.) MWR129300 ICS*V352
RCIC steam supply drain pot LS-N010 isolation valve blowing steam. Replaced packing rings.

13.) MWR129578 E51*AOVF025
Valve did not stroke fully closed. Calibrated per PM MWP524704 and LCR ICS.025. Stroke now satisfactory.

14.) MWR128460 E51*AOVF026
Valve packing blown out. Removed actuator. Installed new packing set in stuffing box. Reinstalled.

TABLE 1

RCIC MAINTENANCE OUTAGE

3/5/89 - 53 hours

1.) MWP524063 ILICS.022 IC 04467
Performed loop calibration on E51*PT007. Satisfactory.

2.) MWP524661 E51*MOVF022 EL 01994
Performed PMP-1205.

3.) MWP524663 E51*MOVF045 EL 01996
Performed PMP-1205.

4.) MWP528686 E51*TC002 ME 03192
Oil sample. Added oil.

5.) MWP524659 E51*MOVF010 EL 01991
Performed PMP-1205.

TABLE 1

RCIC MAINTENANCE OUTAGE

3/14/89 - 24 hours

Uncouple RCIC turbine/pump to perform overspeed test TSP-0010.

1.) MWR112341
Turbine failed overspeed test.

2.) MWP524659 E51*MOVF010 EL 01991
Performed PMP-1205. No lube required. Lugs inspected. Satisfactory.

3.) MWR127166 E51*MOVC002
RCIC governor valve appeared to be sticking, sluggish during overspeed test. Prepared MWR124615.

TABLE 1

RCIC MAINTENANCE OUTAGE

9/26/89 - 37 hours

1.) MWP527413 ILCS.015 IC04462
Performed MCP-4001 with sat results. Cleaned each device.

2.) MWP533360 E51*PC003 ME 01555
Greased coupling. Checked for loose screws & bolts. Satisfactory.

3.) MWP533442 E51*TC002 ME03074
Cleaned and lubricated linkages. Checked governor valve stroke. Checked proper spring tension.

4.) MWP533537 E51*PC003 ME 01554
Changed oil.

5.) MWP534181 E51*PC001 ME 01556
Lubricated coupling. Checked for leaks, loose bolts, etc. None found.

6.) MWP534182 E51*PC001 ME 01557
Changed pump bearing oil.

7.) MWR131833 ICS*V61
Packing leak. Adjusted packing.

8.) MWR131858 E51*TC002
Added oil to turbine.

9.) MWP527485 ILICS.016 IC 04463
Performance of this PM will cause E51*MOVF019 to open which causes the suppression pool level to rise. Need to change PM to lift leads on relay E51-K73A. Performed loop calibration. Satisfactory. MCP-4001.

10.) MWP533441 E51*TC002 ME 03192
Obtained oil sample.

TABLE 1

RCIC MAINTENANCE OUTAGE

12/29/89 - 26 hours

1.) MWP536822 E51*PC002 ME 01546
Changed oil, gland seal compressor.

2.) MWR132279 E51*PC003
(Should be MWP)
Changed oil. Took sample to chemistry.

3.) MWR132280 E51*PC001
(Should be MWP)
Changed oil and took sample to chemistry.

TABLE 1

RCIC MAINTENANCE OUTAGE

4/23/90 - 25 hours

1.) MWE538386 E5 PMC003 EQ 02958
Lubricated motor.

2.) MWE539837 E51*.TN007 EQ 01537
Performed loop check. LCR 1ILICS.022. One point was out. Performed calibration of 1ECS-PI602 per MCP4000. Adjusted the zero. Calibration satisfactory.

3.) MWP539040 E51*TC002 ME 03074
Cleaned and lubricated all external governor and control linkage. Checked governor valve stroke, satisfactory. Verified proper spring tension, satisfactory.

4.) MWP539311 E51*PMC003 EL 01990
Performed PMP1065.

5.) MWR056530 E31*ESN684A
Unable to calibrate during STP-207-4248. Tried again with acceptable results.

6.) MWR130383 ICS-RV159
Oil leak. Put pipe sealant compound on cap threads. There was no gasket for cap.

7.) MWR135962 ICS*V58
Packing leak. Installed new packing.

TABLE 1

RCIC MAINTENANCE OUTAGE

5/20/90 - 57 hours

1.) MWR112346 1E51-PI175
Broken guage. Replaced with new guage.

2.) MWR112347 1E51-PI176
Broken guage. Replaced with new guage.

TABLE 1

RCIC MAINTENANCE OUTAGE

7/16/90 - 74 hours

1.) MWP541658 E51*PC003 ME 01554
Changed oil.

2.) MWP541954 E51*TC002 ME 03074
Linkage movement sat. Governor valve stroke sat. Spring tension sat. Linkage was well lubricated.

3.) MWR137996 ICS-RV159
Installed gasket which was missing.

4.) MWR138201 ICS*V61
Packing leak. Repacked valve.

5.) MWR138309 E51*RVF018
Installed new relief valve.

TABLE 1

RCIC MAINTENANCE OUTAGE

8/14/90 - 96 hours

1.) MWP541979 E51*C002 EL01988
Performed inspection per PMP1067. No grease needed at this time.

2.) MWE541927 E51*PMC003 EQ 02958
Checked lubrication. No need to lubricate.

3.) MWE542273 E51*LSN037 IQ 00178
Couldn't check.

4.) MWE542337 E51*LSN010 IQ 00177
The two micro switches on E51*LSN010 were a little discolored. Manually manipulated the switch to make valve E51*AOVF054 stroke. Checked with operations to verify annunciator and valve indication.

5.) MWR138083 E51-A-K66
Installed new relay in accordance with MR86-1020. Time delay relay.

6.) MWR138085 E51A-K72
Installed new relay in accordance with MR86-1020. Time delay relay.

7.) MWR138086 E51A-K86
Installed new relay in accordance with MR86-1020. Time delay relay.

TABLE 1

RCIC MAINTENANCE OUTAGE

9/13/90 - 24 hours

System tagged out to support STP-209-3884 for LLRT of E51*MOVF031 and E51*MOVF019. LCO 90-523. Clearance 90-1220

TABLE 1

RCIC MAINTENANCE OUTAGE

3/21/91 - 46 hours

1.) MWP548961 E51*TC002 ME 01549
Changed oil and filters.

2.) MWP548377 E51*TC002 ME 03074
Cleaned governor externals, check governor movement, greased external linkages. Valve stroke (sat). Valve spring coil gap (sat).

3.) MWP548376 E51*TC002 ME 03192
Added 3 quarts oil. Ran "slow". Took oil sample.

4.) MWP546842 E51*PC001 ME 01557
Changed oil.

5.) MWR143620 ICS*TS152
Oil leaking around temperature sensor. Removed temp. element well from pipe and cleaned. Applied PST to threads and reinstalled. Sat.

6.) MWR142965

7.) MWR132053

TABLE 1

RCIC MAINTENANCE OUTAGE

6/19/91 - 30 hours

1.) MWP550231 E51*TC002 ME 03074
Cleaned and lubricated all external governor controls and linkage. Checked governor valve stroke (sat). Checked spring tension (sat).

2.) MWE549991 E51*LSN037 IQ 00178
Checked annunciator actuation (sat). Observed valve AOVF005 switch action. No problems found.

3.) MWE550078 E51*LSN010 IQ 00177
Manually manipulated E51*LSN010. Observed proper operation of valve E51*AOVF054 and annunciator operation.

4.) MWP545896 ILICS.034 IC 04479
Observed proper valve operation.

5.) MWP545847 ILICS.035 IC 04480
Observed proper valve operation.

6.) MWP545883 ILICS.040 IC 04485
Removed switches to I/C shop. Calibrated per MCP-4000. Loop check per MCP-4001. Returned to service.

7.) MWP545867 ILICS.042 IC 04487
Removed for calibration. Calibrated. Loop check.

8.) MWP545875 ILICS.048 IC 04490
Removed for calibration. Calibrated. Loop check.

9.) MWP545852

10.) MWR132009

11.) MWR137812

12.) MWR142965

TABLE 1

RCIC MAINTENANCE OUTAGE

13.) MWR144934

14.) MWR145786

15.) MWR146916

16.) MWR147745

TABLE 2

FORCED MAINTENANCE OUTAGE

DATE	DOWN TIME	COMMENTS
2/2/88	Few minutes	RCIC inadvertent isolation during STP-207-4239. Lifted lead problem. CR88-0177.
2/4/88	19 minutes	RCIC inadvertent isolation during STP-207-4537. Lifted lead problem. CR88-0177.
2/7/88	7 hours	RCIC isolated when E31*N610A placed in trip condition due to failure of E31*N610A reed switch. Sent isolation signal to E51*MOVF064. LCO 88-43. MWR056017.
2/23/88	25 minutes	RCIC inadvertent isolation during STP-207-4538. CR88-0177.
2/26/88	5 hours	Wrong type of lube oil added to pump. Drain, refill. [illegible] 88-071. MWR056101.
3/4/88	few minutes	Tripped turbine while performing STP-207-4249. Inadequate procedure. CR88-0207.
5/4/88	4 hours	Key holding the torque arm to the valve stem on E51*MOVF078 had fallen off allowing possible stem rotation during operation. Replaced the key. LCO 88-128 and 129. MWR115034. CR88-0370.

TABLE 2

FORCED MAINTENANCE OUTAGE

DATE	DOWN TIME	COMMENTS
6/15/88	98 hours	Following planned maintenance. Ran RCIC. Pump did not meet delta P and speed reference values. CR88-0467. Clearance 88-0573. MWR112350, MWR115615, MWR116745, MWR117412, MWP518975, MWR115628, Clearance 88-0592. MWR110931, MWR115635, Clearance 88-0583. Clearance 88-0592. MWR110931. STP-209-3301.
7/9/88	13 hours	Replace packing on E51*AOVF026. Clearance 88-0654. MWR106376. LCO 88-200. STP-209-3301 on AOVF026.
9/16/88	2 hours	RCIC isolation during STP-207-4295. Lifted lead problem. CR88-0731.
10/12/88	8 hours	Steam leak on E51*MOVF064 Tightened packing nuts. LCO 88-381. MWR117459.
12/6/88	119 hours	Valve leaking steam. RCIC steam flow transmitters inop. RCIC isolation. Clearance 88-1222, 88-1233, 88-1240. Condition Report 88-0905 and 88-0912. RCIC turbine tripped on overspeed. STP-209-3301.
12/21/88	67 hours	Maintenance to insure seismic qualification. Clearance 88-1300. Work on oil leak on governor. Clearance 88-1305. MWR129958 and MWR128497.

TABLE 2

FORCED MAINTENANCE OUTAGE

DATE	DOWN TIME	COMMENTS
1/25/89	26 hours	Repair E51*AOV26. Clearance 89-0117.
2/10/89	11 minutes	RCIC isolation due to technician error. CR89-0108.
2/14/89	3 hours	Level indicator B21-N695A declared inop. Clearance 89-0242. LCO 89-099, LCO 89-100. MWR129647.
9/7/89	1 hour	RCIC isolation during STP-207-453. CR89-1008.
10/8/89	85 hours	Short in fuse holder during STP-207-4530. LCO 89-475. CR89-1092 and 1095. Clearance 89-2505. MWR130447, 130639.
11/13/89	3 hours	Lost LNB "A" dc bus. Got RCIC initiation. RCIC isolation. No RPV injection occurred.
11/15/89	82 hours	Leak on E51*AOV54. LCO 89-558. Clearance 89-2719. MWR130638. MWR130690 - air leak on E51*AOVF004. MWR131051 - Replace air hose E51*AOVF005.
12/11/89	14 minutes	RCIC isolation during STP-207-4539. CR89-1276.
1/2/90	9 hours	Tagged out to work on exhaust drain trap. Clear high level alarm. LCO 90-004. Clearance 90-0008.

TABLE 2

FORCED MAINTENANCE OUTAGE

DATE	DOWN TIME	COMMENTS
1/3/90	50 hours	RCIC tripped on overspeed during STP-209-3302. LCO 90-007. Clearance 90-0017. CR's 90-0005, 90-0007.
2/11/90	1 hour	Topaz inverters to H13-P618 and H13-P652 failed. Closed Group II valves on RCIC per Tech Spec. 3.3.2
11/30/90	1 hour	E51*MOVF064 stuck closed. Dispatched operator to open.
12/1/90	3 hours	Trouble with RCIC alarms in control room. LCO 90-660.
12/2/90	120 hours	Manually tripped RCIC shortly after start due to relief valve lifted. Trip on overspeed. E51*MOVF019 cycling. CR90-1249 states the root cause of overspeed trips was a failed linear position transducer (LPT) for ERIS point E51EA011. Also other problems LCO 90-664, 666, 671. Clearance 90-2214. CR90-1210.

TABLE 3

RCIC STARTS

DATE	RUN TIME	START/STOP	COMMENTS
2/8/88	37 minutes	1543 - 1620	STP-209-3302
2/8/88	11 minutes	2019 - 2030	After trouble-shooting.
3/2/88	8 minutes	1522 - 1530	For pre torque warmup.
3/2/88	8 minutes	1555 - 1603	STP-209-3302
4/6/88	30 minutes	1350 - 1420	STP-209-3302
6/14/88	20 minutes	1455 - 1515	STP-209-3302
6/17/88	21 minutes	1029 - 1050	SOP-0035
6/19/88	25 minutes	1940 - 2005	SOP 0035
6/20/88	7 minutes	0305 - 0312	SOP 0035 and STP-209-3302
9/10/88	40 minutes	1740 - 1820	STP-209-3302
11/2/88	40 minutes	1027 - 1107	STP-209-3302
12/11/88	---	0108	Tripped on overspeed.
12/11/88	29 minutes	1426 - 1455	STP-209-3302

TABLE 3

RCIC STARTS

DATE	RUN TIME	START/STOP	COMMENTS
12/23/88	4 minutes		Shutdown RCIC turbine after 4 minutes due to oil leak on RCIC governor. Clearance 88-1305. MWR128497. Tom Scheibal indicates turbine could have continued to run. Oil leak was small.
12/24/88	28 minutes	0806 - 0834	STP-209-3302
1/27/89	28 minutes	0044 - 0112	After maintenance
2/19/89	16 minutes	2241 - 2257	After scram
6/19/89	assume 30 min.	1150 - 1430	STP-209-0601 & 0602
6/20/89	7 minutes	2005 - 2112	STP-209-3302
7/29/89	33 minutes	1323 - 1356	STP-209-3302
9/28/89	31 minutes	1418 - 1449	STP-209-3302
10/12/89	8 minutes	1159 - 1207	After maintenance
11/13/89	unknown	lost dc bus	RCIC isolated, then initiated. No injection into vessel.
1/3/90	---	1130	Tripped on over speed.

TABLE 3

RCIC STARTS

DATE	RUN TIME	START/STOP	COMMENTS
1/5/90	35 minutes	1352 - 1427	STP-209-3302.
4/24/90	20 minutes	0435 - 0455	SOP 035
4/26/90	31 minutes	1328 - 1359	STP-209-3302
7/19/90	23 minutes	2321 - 2344	STP-209-3302
12/2/90	---	0959	Tripped on overspeed.
12/7/90	40 minutes	1020 - 1100	STP-209-3302
3/23/91	76 minutes	0444 - 0600	STP-209-3302
3/23/91	57 minutes	0917 - 1014	STP-209-3302
3/23/91	16 minutes	1457 - 1513	SOP 035
03/24/91	34 minutes	1706 - 1740	STP-209-3302
05/20/91	24 minutes	1516 - 1540	STP-209-3302
05/20/91	61 minutes	1739 - 1840	STP-209-3302
6/21/91	35 minutes	1537 - 1612	STP-209-3302
6/21/91	90 minutes	2051 - 2221	STP-209-3302

TABLE 4
SURVEILLANCE FREQUENCY CHANGES

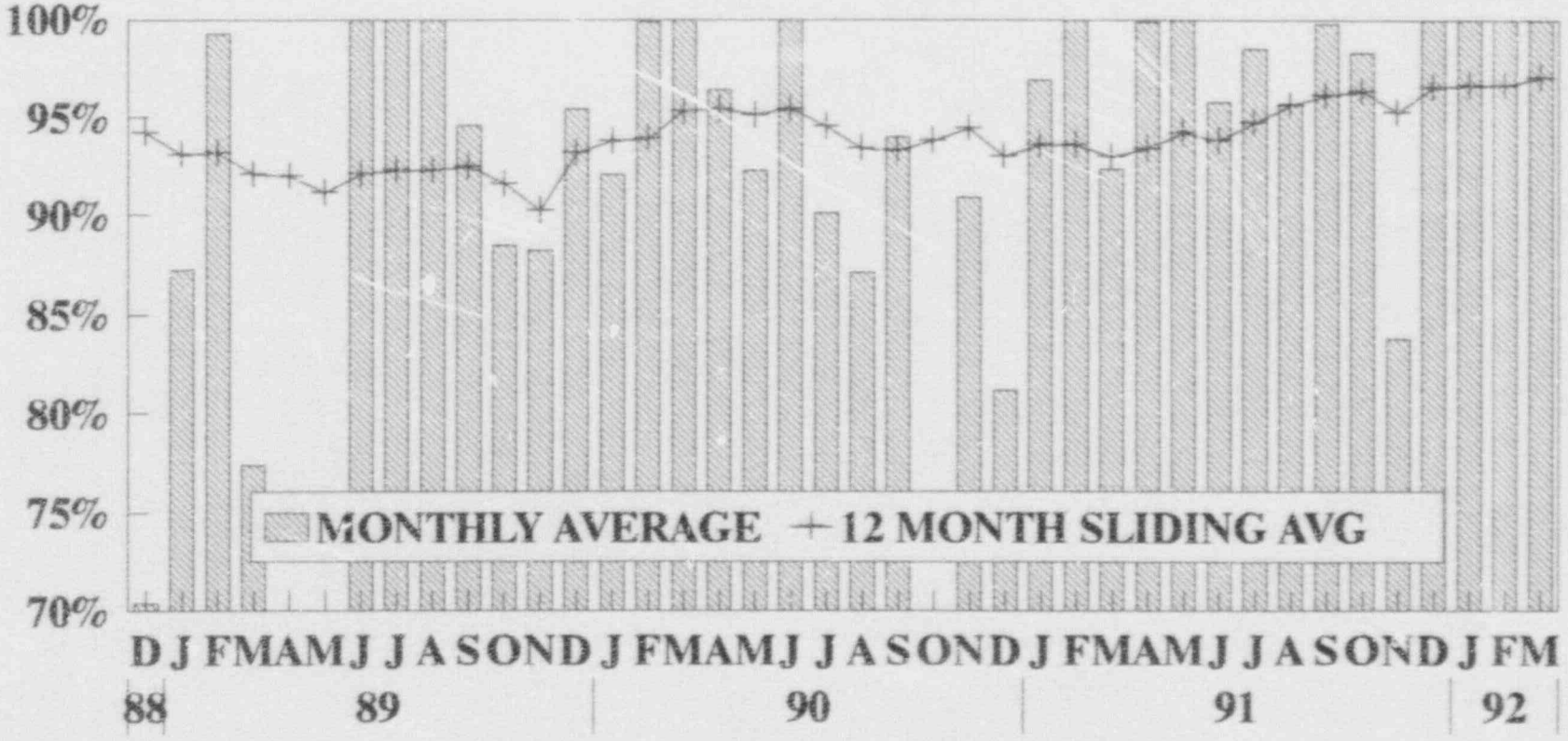
STP	PRESENT	RECOMMENED
STP-207-4205	Monthly Functional	Every six months
STP-207-4206	Monthly Functional	Every six months
STP-207-4209	Quarterly calibration	Every six months
STP-207-4210	Quarterly calibration	Every six months
STP-207-4240	Monthly functional	Every six months
STP-207-4241	Monthly functional	Every six months
STP-207-4242	Monthly functional	Every six months
STP-207-4243	Monthly functional	Every six months
STP-207-4294	Quarterly calibration	Every six months
STP-207-4295	Quarterly calibration	Every six months
STP-207-4501	Monthly functional	Every three months
STP-207-4502	Monthly functional	Every three months
STP-207-4536	Monthly functional	Every six months
STP-207-4537	Monthly functional	Every six months
STP-207-4538	Monthly functional	Every six months
STP-207-4539	Monthly functional	Every six months
STP-207-4548	Monthly functional	Every six months
STP-207-4549	Monthly functional	Every six months
STP-207-5248	Monthly functonal	Every six months
STP-207-5249	Monthly functional	Every six months
STP-207-5250	Monthly functional	Every six months
STP-207-5251	Monthly functional	Every six months
STP-207-5252	Monthly functional	Every six months
STP-207-5253	Monthly functional	Every six months
STP-207-5254	Monthly functional	Every six months
STP-207-5255	Monthly functional	Every six months
STP-209-4201	Monthly functional	Every six months
STP-209-4202	Monthly functional	Every six months
STP-209-4204	Monthly functional	Every six months
STP-209-4205	Monthly functional	Every six months
STP-209-4206	Monthly functional	Every six months
STP-209-4207	Monthly functional	Every six months
STP-209-4211	Monthly functional	Every six months
STP-209-5201	Monthly functional	Every six months
STP-209-5202	Monthly functional	Every six months

TABLE 5
STP ADJUSTMENT HISTORY

STP	NUMBER OF SURVEILLANCES REVIEWED	RECOMMENED
STP-207-4205	32	ZERO
STP-207-4206	32	ZERO
STP-207-4209	13	ZERO
STP-207-4210	14	ZERO
STP-207-4240	28	ZERO
STP-207-4241	30	ZERO
STP-207-4142	29	ONE
STP-207-4243	30	TWO
STP-207-429[illegible]	13	ZERO
STP-207-4295	11	ZERO
STP-207-4501	32	THREE
STP-207-4502	31	FOUR
STP-207-4536	31	THREE
STP-207-4537	29	ZERO
STP-207-4538	30	TWO
STP-207-4539	31	ONE
STP-207-4548	30	ZERO
STP-207-4549	31	FIVE
STP-207-5248	30	ONE
STP-207-5249	30	TWO
STP-207-5250	29	TWO
STP-207-5251	30	ZERO
STP-207-5252	28	THREE
STP-207-5253	29	ONE
STP-207-5254	28	ZERO
STP-207-5255	30	ZERO
TP-209-4201	30	ZERO
STP-209-4202	30	ZERO
STP-209-4204	28	THREE
STP-209-4205	28	TWO
STP-209-4206	27	ONE
STP-2094207	29	ZERO
STP-209-4211	27	TWO
STP-209-5201	29	TWO
STP-209-5202	29	ONE

RCIC

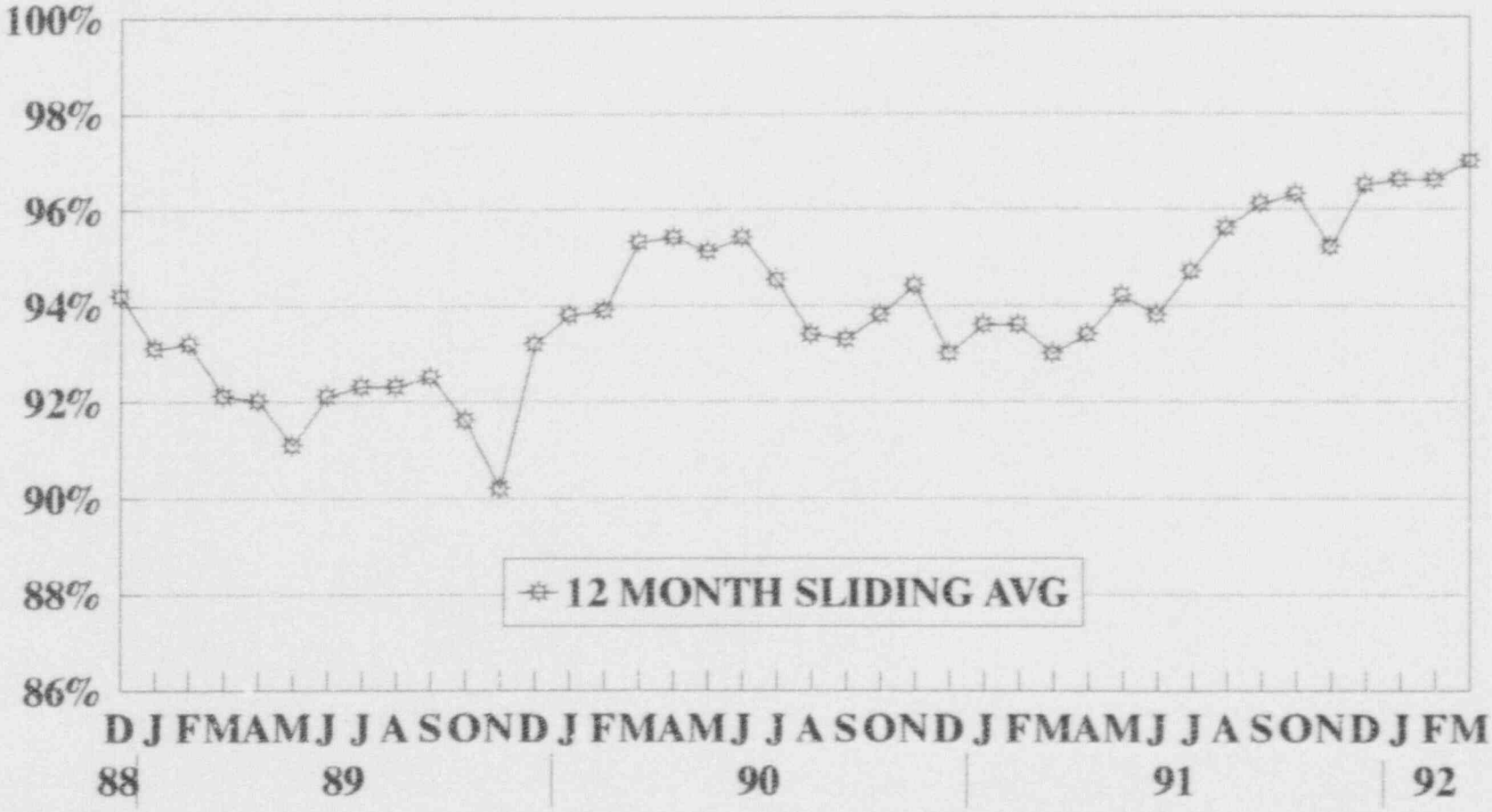
12 MONTH SLIDING & MONTHLY STANDBY AVAILABILITY



INCLUDES PLANNED AND FORCED MAINTENANCE HOURS

RCIC

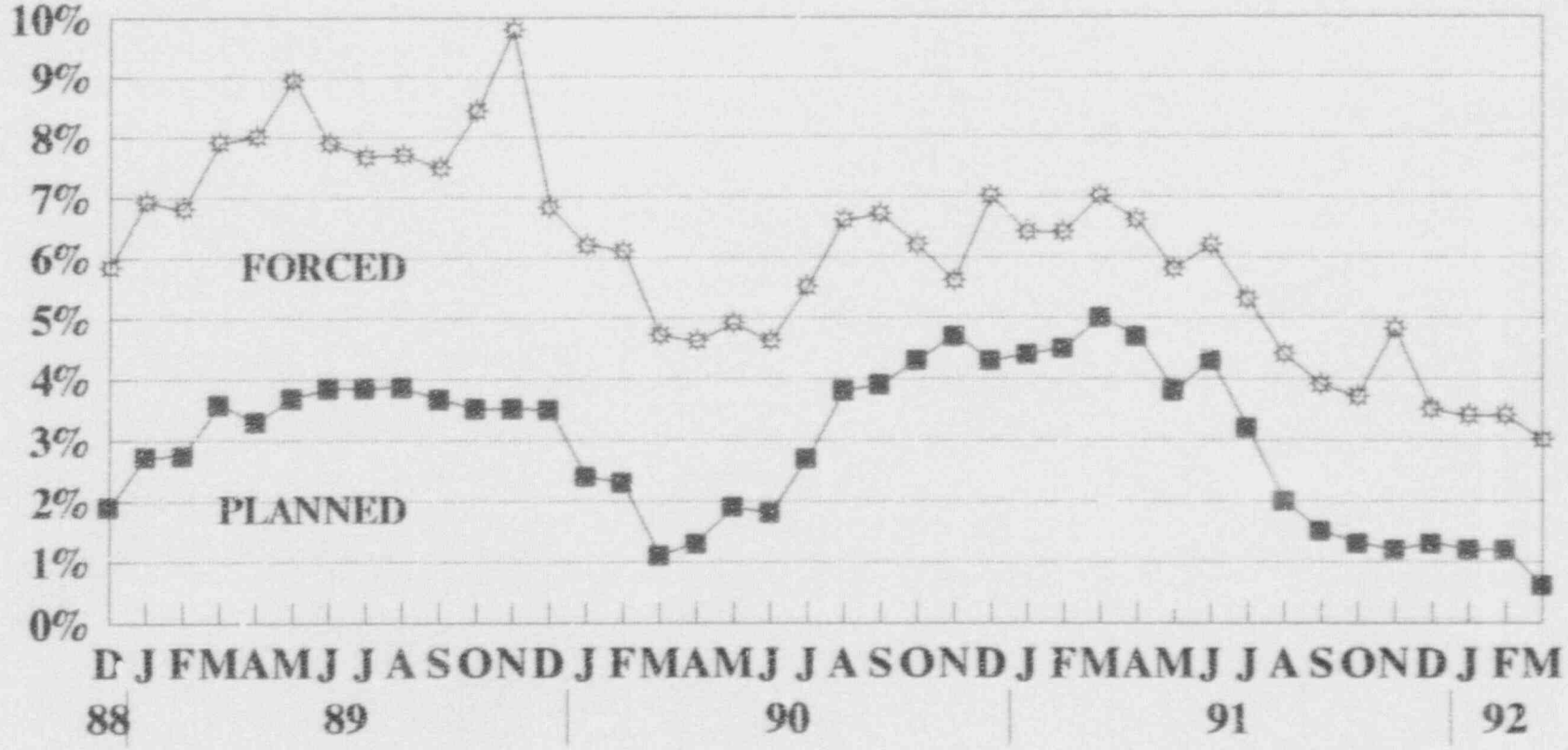
STANDBY AVAILABILITY



THIS CURVE REPRESENTS THE PROBABILITY OF RCIC NOT BEING IN PLANNED OR FORCED MAINTENANCE OVER 12 MONTH PERIOD.

RCIC

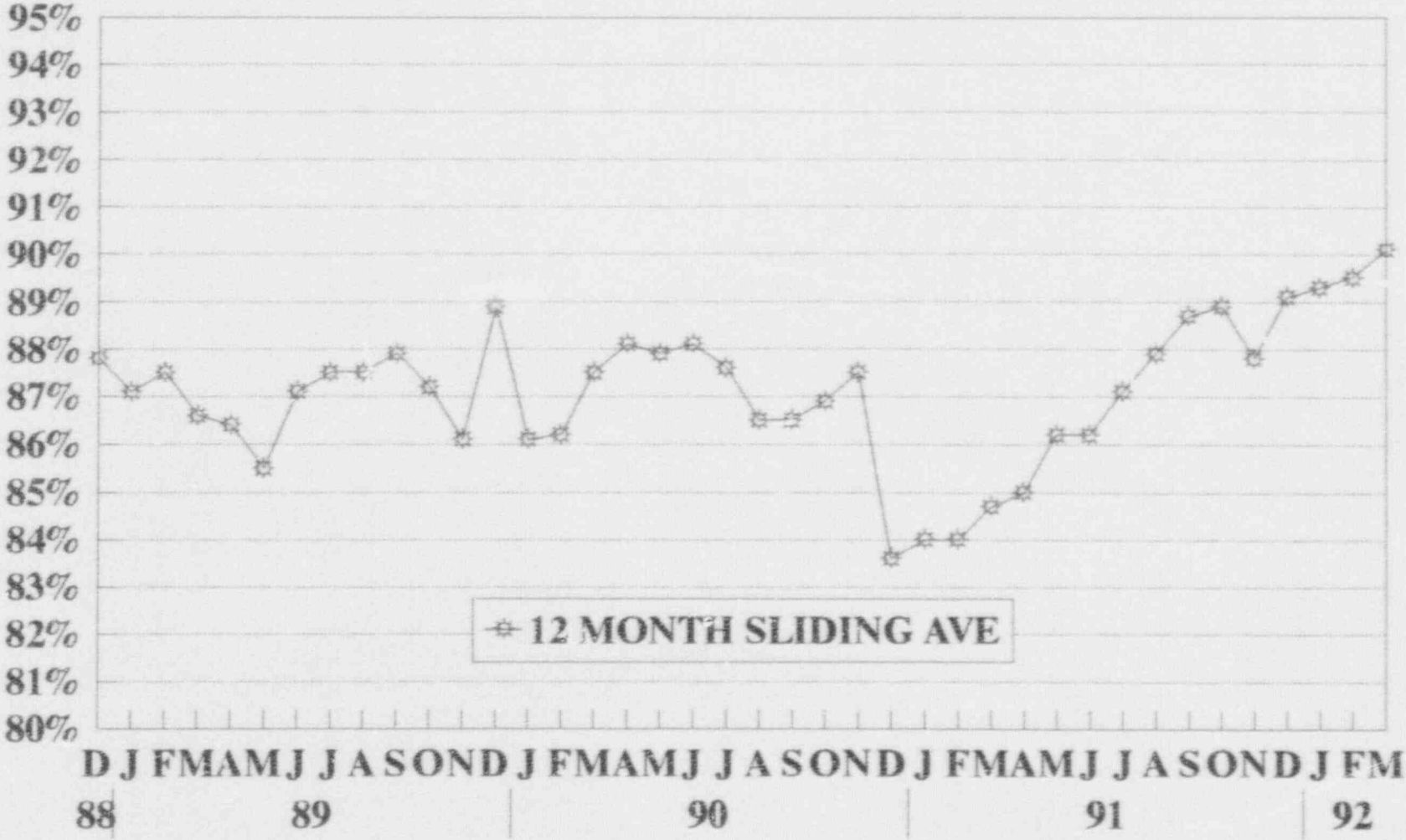
STANDBY UNAVAILABILITY
12 MONTH SLIDING AVERAGE



TOTAL INCLUDES PLANNED AND FORCED MAINTENANCE HOURS

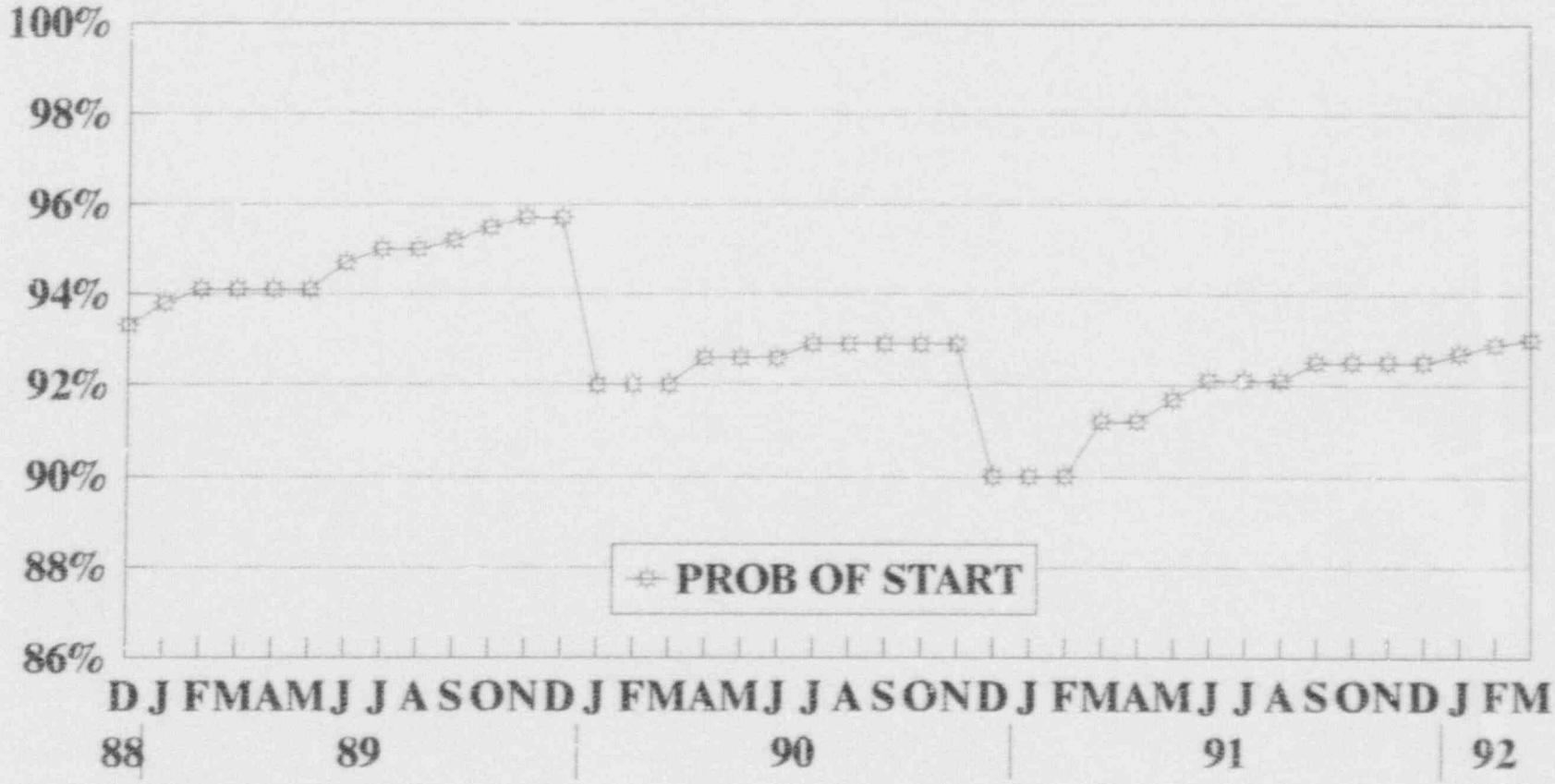
REACTOR CORE ISOLATION COOLING

CONDITIONAL PROBABILITY



CURVE REPRESENTS THE PROBABILITY OF RCIC START AND RUN FOR 4 HOURS WITHOUT OPERATOR ACTION FOR A RANDOM DEMAND

RCIC
PROBABILITY OF START



CUMULATIVE SUCCESSFUL STARTS DIVIDED BY TOTAL STARTS SINCE JAN 1988.