FITZPATRICK - 24 MONTH OPERATING CYCLE

CONTROL ROD DRIVE SURVEILLANCE TEST EXTENSIONS

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24 MONTH OPERATING CYCLE
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CRD SURVEILLANCE TEST EXTENSIONS

I. Executive Summary

The FitzPatrick plant will be operating on a 24 month fuel cycle. This longer cycle length has a direct effect on surveillance, maintenance, and test activities that are currently performed on a 18 month or refuel outage basis.

At FitzPatrick, the Control Rod Drive (CRD) System components are routinely inspected, tested, and maintained to provide a highly reliable system. The control rod system is subjected to tests which verify: 1) reactivity margin, 2) coupling integrity, 3) the capability of the Rod Worth Minimizer to properly fulfill its function and 4) scram insertion times. In addition, preventive maintenance (PM) is periodically performed on individual CRD components.

CRD test frequencies are mandated by the plant's technical specifications. Maintenance activities are based on operational feedback and manufacturer's recommendations.

This study evaluates the changes to maintenance and surveillance requirements to support a nominal twenty four month fuel cycle. Justification is provided, where appropriate, to support test extensions.

Our evaluations conclude that 1) CRD surveillance intervals can be safely extended to support a nominal 24 month operating cycle and 2) CRD maintenance activities are not impacted by the longer cycle.

II. Purpose

The FitzPatrick plant will be operating on a 24 month fuel cycle. To avoid either an 18 month surveillance outage or an extended mid-cycle outage, changes are required to the CRD system surveillance test intervals prescribed by the FitzPatrick Technical Specifications. Substantiating the impacts of the longer cycle length on the CRD system surveillance, maintenance, and test activities requires a comprehensive review of the system, its individual components, and the integrated effect of all test and maintenance activities on operability.

III. Evaluation

CRD test, maintenance, and inspection activities were methodically evaluated to determine the impacts of a 24 month operating cycle. The longer cycle length requires an extension of 1) reactivity margin test, 2) scram time testing and 3) Scram Discharge Instrument Volume (SDIV) vent and drain valve operability test. Other CRD surveillances are either performed during power operation or are not directly impacted by the longer fuel cycle. These surveillances are:

- exercising each partially or fully withdrawn operable control rod when operating above 30% power (daily)
- verifying scram discharge volume drain and vent valves open (monthly)
- checking pressure and level alarms for the accumulators (weekly)
- performing shutdown margin test when it is determined that a control rod is incapable of normal insertion (conditional)
- stroke testing scram discharge volume drain and vent valves (quarterly)
- verifying control rod coupling integrity (conditional)
- inspection of control rod drive housing support system after reassemble (conditional)
- demonstrating capability of the Rod Worth Minimizer to fulfill its function (conditional)
- verifying count rates of source range channels (conditional)
- performing instrument functional test of the Rod Block Monitor (conditional)
- scram time testing 10% of operable control rod drives (every 16 weeks)
- comparing critical rod configuration (start-up following refueling and at least every full power month).

The frequencies of these surveillances are shown in parentheses. A "conditional" frequency is on that is dependent upon a certain situation e.g.,

control rod coupling integrity is verified when a rod is withdrawn the first time after each refueling outage or after maintenance.

CRD preventive maintenance activities are either performed during power operation or are not cycle length dependent (References 1 & 2). For example, the CRD flow instrumentation is already calibrated on a 24 month cycle.

The operability of systems and components required by the plant's safety analyses is established by the surveillance requirements contained in the Technical Specifications. Surveillance testing, by definition, can only identify that a component or a system is incapable of performing its safety function (i.e., inoperable). Preventive maintenance, however, reduces the number of failures found during plant operation or during testing.

The decision to extend surveillance test intervals considers:

1. the system's safety function;

2. the integrated effect of testing and maintenance activities on system operability, and

3. the burden of testing at power. For example; testing that could lead to a plant transient, testing that results in unnecessary equipment wear or radiation exposure to plant personnel.

These considerations are applied to the FitzPatrick CRD system:

1. System Safety Function

   The CRD system is the primary reactivity control system for the reactor. The safety function of the CRD system is to provide rapid reactivity control (reactor scram) so that no fuel damage results from any abnormal operating transient. The system also provides for controlling flow and pressure to and from the control rod drives for incrementally positioning control rods, and for cooling the drive. Each control rod is moved by a Control Rod Drive attached to the control rod mechanically. The drive is basically a double acting hydraulic cylinder using condensate water as the operating fluid. The drive is capable of inserting or withdrawing the rod at a slow, controlled rate as well as providing scram insertion for rapid shutdown of the reactor. A locking mechanism in the drive permits the control rod to be positioned at fixed increments of stroke and to be held in a latched position for indefinite periods of time. The Control Rod Drive Hydraulic System supplies the required pressures and flows to position the

control rods, cool the drives, plus supplies water for the scram. The system is normally supplied with water from the condensate system at 20 to 25 psig at the pump suction.

The scram discharge volume receives exhaust water from the control rod hydraulic control units during a scram. The volume is divided into two individual headers each with an associated instrument volume. The discharge volume headers are vented via two in series vent valves that connect to their respective instrument volumes. The discharge volumes are drained from their respective instrument volumes via two in series drain valves to the east and west Reactor Building equipment sumps. The vents and drains isolate during a reactor scram to prevent a continuous loss of water from the reactor or control rod drive system during a scram.

2. Testing and Maintenance Activities

A review of CRD surveillance testing and maintenance activities was conducted to determine the effect, if any, extension of certain tests would have on system reliability and operability.

2.1. Surveillance Testing

The following CRD surveillance tests are performed once per operating cycle or once per refueling outage:

Reactivity Margin - Core Loading (RAP 7.3.9):

This test is performed following a refueling outage when core alterations are performed. The purpose of this test is to demonstrate with a margin of 0.38 percent $\Delta k/k$ that the reactor will be subcritical throughout the fuel cycle with the analytically determined strongest control rod fully withdrawn and all other rods inserted. The margin is demonstrated by bringing the reactor core to criticality, from a xenon free condition, by withdrawing control rods in a normal start-up sequence. The reactivity added to the core to bring the reactor critical is then calculated. The calculated worth of the rods withdrawn must be greater than the worth of the strongest rod by 0.38% + R. The term R is the difference between calculated value of maximum core reactivity during the operating cycle and the calculated beginning of cycle core reactivity. By definition R is ≥ 0.

Control Rod Scram Time Testing (RAP 7.3.10):

After each refueling outage, all operable control rods are scram time tested from the fully withdrawn position with the reactor at a pressure above 950 psig. This testing is completed prior to exceeding 40% power. The CRD system is designed to bring the reactor subcritical at a rate fast enough to prevent fuel damage. The design basis transient and accident analyses assume that all of the control rods scram at a specified insertion rate. Surveillance of each individual control rod's scram time ensures that the scram time assumed in the design basis transient and accident analyses can be met (i.e. Technical Specification values are not exceeded).

SDIV Vent And Drain Valve Operability (ST-29B):

This once per operating cycle test demonstrates the scram discharge volume vent and drain valves close in less than 30 seconds from the time the reactor mode switch is placed in "shutdown". This test was added to the FitzPatrick Technical Specifications in 1982 to reduce the susceptibility of Scram Discharge Volume (SDV) Systems to common cause failures (Reference 11). This once per cycle test is an integrated test of the SDIV drain and vent valves which demonstrates total system performance. It provides assurance that the valves operate automatically to: 1) close during scram to limit the amount of reactor coolant discharged (leakage past the CRD seals) and 2) open on scram reset to maintain the SDV vent and drain path open so that there is sufficient volume to accept the reactor coolant discharged during a scram. The test also verifies that time delay reset relays prevent resetting the trip for at least 10 seconds and thus provides assurance that a scram signal is not reset until the rods are fully inserted.

2.2. Corrective Maintenance and Equipment Performance

An evaluation of surveillance history, operational occurrences and maintenance programs determined that equipment operability problems are being identified in a timely fashion (References 1, 2, and 3). The maintenance review confirmed that recurring or symptomatic problems affecting operability are being corrected without relying on surveillance tests to identify performance degradation.

3. Burden of Testing during Power Operation

The performance of certain CRD system tests while the plant is on-line is impractical. The reactivity margin (core loading) test and control rod scram time test are directly related to the refueling itself. The reactivity margin test is required following a refueling outage when core alterations are performed. This ensures that, even with the new fuel pattern, the reactor can be made subcritical throughout the new fuel cycle. The control rod scram time test requires all operable control rods be scram time tested after each refueling outage. This ensures that the refueling activity itself has not affected scram times. Operability of the SDIV vent and drain valves is periodically demonstrated during power operation. However, the once per operating cycle mode switch in shutdown test causes a plant scram and is not performed during power operation.

IV. Surveillance Test Changes

The evaluation of CRD test and maintenance activities, and historical equipment performance for CRD components shows changes should be made to the surveillance test intervals for reactivity margin (core loading) test, control rod scram time test and the SDIV vent and drain valve operability test. The reactivity margin and control rod scram tests are conditional surveillances associated with refueling. Thus, these tests are performed following each refuel regardless of cycle length. However, extension of these surveillance test intervals (STIs) is evaluated to ensure that the longer STIs are not a safety concern.

1. Reactivity Margin - Core Loading:

The reactivity margin (core loading) test can be safely extended with the longer fuel cycle. The CRD system is designed to provide sufficient control of core reactivity so that the core could be made subcritical with the strongest rod fully withdrawn. A cold, xenon free shutdown margin demonstration is performed after refueling to ensure that an adequate shutdown margin exists at any exposure point in the fuel cycle. The demonstration will show that the reactor is subcritical by at least R + 0.38% $\Delta k/k$. R is the difference between calculated value of maximum core reactivity during the operating cycle and the calculated beginning of life core reactivity. As such, the calculation accounts for the longer operating cycle. This test is valid for the duration of the fuel cycle. Should changes in rod configuration occur (e.g. stuck rod), the Technical Specifications require re-demonstrating reactivity margin. In addition,

should additional opportunities occur during the fuel cycle to perform an in sequence critical test the data provided will enable further calculations of shutdown margin.

2. Control Rod Scram Time Test:

The control rod scram time test of all operable control rods after each refueling outage can be safety extended with the longer fuel cycle. Operating experience has shown that control rod scram times do not significantly change over an operating cycle. Also, additional on-line surveillance tests verify control rod operability. At 16 week intervals, 10 percent of the operable control rod drives shall be scram timed above 950 psig. In addition, adequate accumulator pressure is verified frequently and the plant Technical Specifications require testing of control rods if work is performed which may affect insertion time.

3. SDIV Vent and Drain Valve Operability:

The once per operating cycle scram discharge volume drain and vent valves operability test (with mode switch in "shutdown") can be safely extended with the longer fuel cycle. Mechanical functionality of the system is assured by stroke testing of valves, individual control rod stroke tests and verifying valve position and accumulator level and pressure. These tests and verifications are performed while the plant is on-line. Thus on-line testing provides adequate assurance of valve operability.

Functionality of the scram circuitry, the mode switch and the reset relays is also assured periodically. The scram circuitry has previously been evaluated for the longer cycle length as part of the RPS Surveillance Test Improvements report (Reference 12). Operability of the mode switch and reset relays is demonstrated during forced and planned shutdowns. When the mode switch is placed in "shutdown" all control rods should be fully inserted. Any operability problems would be revealed by annunciators or indicating lights.

A review of the Inservice Test (IST) program valve test records for the quarterly SDIV vent and drain valves full stroke timing test shows that they have been performing well. From February 1987 through March 1991, one test result indicated unsatisfactory stroke times for three out of

eight SDIV vent and drain valves. All the other test results were satisfactory for each of the SDIV vent and drain valves.

A review of operating occurrence reports (1986 - 1990) indicates that problems with the scram discharge volume drain and vent valves are being identified through on-line testing and monitoring during normal operation of the system.

V. Summary and Conclusions

To support the 24 month fuel cycle, extension of the once per refueling outage and once per operating cycle CRD surveillance test intervals is proposed.

The reactivity margin (core loading) test and control rod scram time test are conditional surveillances which are performed following refueling outages. The reactivity margin test can be safely extended with the longer fuel cycle because: 1) the calculation accounts for the longer fuel cycle and 2) if changes in rod configuration occur (e.g. stuck rods), the Technical Specifications require re-demonstrating reactivity margin. The control rod scram time test can be safety extended with the longer fuel cycle because: 1) operating experience has shown that control rod scram times do not significantly change over an operating cycle and 2) on-line surveillance testing verifies control rod operability.

Verification of SDIV vent and drain valve operability (with mode switch in "shutdown") is performed once per operating cycle. This test consists of two parts: 1) demonstrating operability of the reactor mode switch and reset relays and 2) verification that the SDIV vent and drain valves close in less than 30 seconds. The scram circuitry has been previously evaluated for the longer fuel cycle as part of the RPS Surveillance Test Improvements Report. Operability of the mode switch and reset relays is demonstrated during forced and planned shutdowns. Any control rod operability problems would be revealed by annunciators or indicating lights. The second part of the test can be safely extended with the longer fuel cycle since on-line testing demonstrates SDIV vent and drain valve operability. In addition, past performance of the valves has been good.

Although the surveillance test interval of these tests is being extended with the longer fuel cycle, no revision to the Technical Specification is required. This is because the surveillance test intervals are stated as each refueling outage or once per operating cycle. However, it is recommended the surveillance test intervals could be explicitly identified as "once every 24 months". Marked up Technical Specification pages are included in Attachment 2.

VI. References

1. James A. FitzPatrick Nuclear Power Plant, Maintenance Department Preventive Maintenance Schedule, dated September 24, 1990.

2. James A. FitzPatrick Nuclear Power Plant, I&C Department Maintenance Program Master Schedule, dated October 11,1990.

3. Operational Occurrence Report Logs from 1986 to 1990.

4. Reactor Analyst Procedure No. 7.3.9, "Shutdown Margin Check", Revision 14, dated January 19, 1990.

5. Reactor Analyst Procedure No. 7.3.10, "Control Rod Scram Time Evaluation," Revision 4, dated March 17, 1981.

6. Operations Surveillance Test Procedure No. 20K, "Control Rod Exercise/Venting," Revision 7, dated March 27, 1991.

7. Operations Surveillance Test Procedure No. 20L, "Scram Discharge Volume Vent and Drain Valves Full Stroke Test," Revision 4, dated October 2, 1985.

8. Operations Surveillance Test Procedure No. 20M, "Scram Discharge Volume Vent and Drain Valves Full Stroke Timing Test (IST)," Revision 3, dated June 27, 1990.

9. Operations Surveillance Test Procedure No. 23B, "Control Rod Coupling Integrity Test," Revision 5, dated December 22, 1987.

10. Operations Surveillance Test Procedure No. 29B, "Mode Switch in Shutdown Functional Test," Revision 11, dated September 13, 1990.

11. NRC Letter, D.G. Eisenhut to All Operating BWRs, dated July 7, 1980.

12. James A. FitzPatrick - 24 Month Operating Cycle, "Reactor Protection System Surveillance Test Improvements," dated February, 1991.

13. James A. FitzPatrick Nuclear Power Plant, Technical Specifications Sections 3.3 and 4.3.

14. James A. FitzPatrick Nuclear Power Plant, Updated Final Safety Analysis Report, Section 3.5.

FITZPATRICK - 24 MONTH OPERATING CYCLE

<u>ATTACHMENT 1</u>

SAFETY EVALUATION

24 MONTH OPERATING CYCLE
CRD SURVEILLANCE TEST EXTENSIONS

I. Safety Evaluation

The proposed changes have been reviewed in accordance with the requirements of 10 CFR 50.59 and 10 CFR 50.92. These changes, which extend the test intervals do not involve an unreviewed safety question nor do they constitute a Significant Hazards Consideration.

1. The probability of occurrence and the consequences of an accident or malfunction of safety-related equipment previously evaluated in the safety analysis report will not be increased.

   Changes are proposed to increase the surveillance test interval (STI) for the reactivity margin test, control rod scram time test and SDIV vent and drain valve operability (with mode switch in "shutdown") test, with the longer fuel cycle. These changes extend the STIs. They do not involve any hardware modifications. There is no increase in (1) the probability of an accident occurring, (2) the consequences of an accident, and (3) the consequences of equipment malfunction. However, increasing the STIs may affect the probability of equipment malfunction.

   Regarding the probability of equipment malfunctions:

   - The reactivity margin (core loading) test can be safely extended with the longer fuel cycle. The calculation of reactivity margins takes into account the longer fuel cycle. In addition, if changes in rod configuration occur, the Technical Specifications require demonstrating reactivity margin again.

   - The control rod scram time test can be safely extended with the longer fuel cycle. Operating experience has shown that control rod scram times do not significantly change over an operating cycle. Also, on-line testing provides adequate assurance of equipment operability.

   - The mode switch in shutdown test of SDIV vent and drain valve operability can be safely extended with the longer fuel cycle. Evaluation of past equipment performance and on-line testing provide adequate assurances of valve operability. Functionality of the scram circuitry is addressed in the RPS Surveillance Test Improvement report. Operability of the mode switch and reset relays is demonstrated during forced and planned shutdowns. Any control rod operability problems would be revealed by annunciators or indicating lights.

2. The possibility of an accident or malfunction of a different type than evaluated previously in the safety analysis report is not created.

   The proposed changes extend STIs. The proposed changes do not change the manner in which the CRD system functions. An evaluation of past equipment performance and a study of on-line testing show the longer STIs will not degrade CRD equipment. Therefore, the proposed changes do not create any new failure modes or a new accident.

3. The margin of safety as defined in the basis for any technical specification is not reduced.

   The proposed changes do not reduce the margin of safety as defined in the basis for any Technical Specification. The proposed changes extend STIs. Evaluation of the past performance of the equipment indicates that the effects of extending the STIs would not involve a significant reduction in a margin of safety.

FITZPATRICK - 24 MONTH OPERATING CYCLE

ATTACHMENT 2

PROPOSED TECHNICAL SPECIFICATION CHANGES

3.3 LIMITING CONDITION FOR OPERATION

3.3 REACTIVITY CONTROL

Applicability:

Applies to the operational status of the Control Rod System.

Objective:

To assure the ability of the Control Rod System to control reactivity.

Specification:

A. Reactivity Limitations

1. Reactivity margin - core loading

A sufficient number of control rods shall be operable so that the core could be made subcritical in the most reactive conditions during the operating cycle with the strongest control rod fully withdrawn and all other operable control rods fully inserted.

4.3 SURVEILLANCE REQUIREMENT

4.3 REACTIVITY CONTROL

Applicability:

Applies to the surveillance requirements of the Control Rod System.

Objective:

To verify the ability of the Control Rod System to control reactivity.

Specification:

A. Reactivity Limitations

1. Reactivity margin - core loading

Once every 24 months

Sufficient control rods shall be withdrawn, following a refueling outage when core alterations were performed, to demonstrate with a margin of 0.38 percent $\Delta k/k$ the core can be made subcritical at any time in the subsequent fuel cycle with the analytically determined strongest operable control rod fully withdrawn and all other operable rods fully inserted.

3.3 (cont'd)

C. Scram Insertion Times

1. The average scram insertion time, based on the de-energization of the scram pilot valve solenoids as time zero, of all operable control rods in the reactor power operation condition shall be no greater than:

Control Rod Notch Position Observed	Average Scram Insertion Time (Seconds)
46	0.338
36	0.923
24	1.992
04	3.554

4.3 (cont'd)

C. Scram Insertion Times

1. Once every 24 months, ~~After each refueling outage,~~ all operable rods shall be scram time tested from the fully withdrawn position with the nuclear system pressure above 950 psig (with saturation temperature). This testing shall be completed prior to exceeding 40% power. During all scram time testing below 10% power, the RWM shall be operable.

3.3.C (cont'd)

2. The average of the scram insertion times for the three fastest operable control rods of all groups of four control rods in a two-by-two array shall be no greater than:

Control Rod Notch Position Observed	Average Scram Insertion Time (Seconds)
46	0.361
38	0.977
24	2.112
04	3.764

3. The maximum scram insertion time for 90 percent insertion of any operable control rod shall not exceed 7.00 sec.

4.3.C (cont'd)

2. At 16-week intervals, 10 percent of the operable control rod drives shall be scram timed above 950 psig. Whenever such scram time measurements are made, an evaluation shall be made to provide reasonable assurance that proper control rod drive performance is being maintained.

3. All control rods shall be determined operable once ~~each operating cycle~~ every 24 months by demonstrating the scam discharge volume drain and vent valves operable when the scram test initiated by placing the mode switch in the SHUTDOWN position is performed as required by Table 4.1-1 and by verifying that the drain and vent valves:

   a. Close in less that 30 seconds after receipt of a signal for control rods to scram, and

   b. Open when the scram signal is reset or the scram discharge instrument volume trip is bypassed.

VI. References

1. James A. FitzPatrick Nuclear Power Plant, Maintenance Department Preventive Maintenance Schedule, dated September 24, 1990.

2. James A. FitzPatrick Nuclear Power Plant, I&C Department Maintenance Program Master Schedule, dated October 11,1990.

3. Operational Occurrence Report Logs from 1986 to 1990.

4. Reactor Analyst Procedure No. 7.3.9, "shutdown" Margin Check", Revision 14, dated January 19, 1990.

5. Reactor Analyst Procedure No. 7.3.10, "Control Rod Scram Time Evaluation," Revision 4, dated March 17, 1981.

6. Operations Surveillance Test Procedure No. 20K, "Control Rod Exercise/Venting," Revision 7, dated March 27, 1991.

7. Operations Surveillance Test Procedure No. 20L, "Scram Discharge Volume Vent and Drain Valves Full Stroke Test," Revision 4, dated October 2, 1985.

8. Operations Surveillance Test Procedure No. 20M, "Scram Discharge Volume Vent and Drain Valves Full Stroke Timing Test (IST)," Revision 3, dated June 27, 1990.

9. Operations Surveillance Test Procedure No. 23B, "Control Rod Coupling Integrity Test," Revision 5, dated December 22, 1987.

10. Operations Surveillance Test Procedure No. 29B, "Mode Switch in "shutdown" Functional Test, "Revision 11, dated September 13, 1990.

11. NRC Letter, D.G. Eisenhut to All Operating BWRs, dated July 7, 1980.

12. James A. FitzPatrick - 24 Month Operating Cycle, "Reactor Protection System Surveillance Test Improvements," dated February, 1991.

13. James A. FitzPatrick Nuclear Power Plant, Technical Specifications Sections 3.3 and 4.3.

14. James A. FitzPatrick Nuclear Power Plant, Updated Final Safety Analysis Report, Section 3.5.