Marked-up Technical Specification Pages

Proposed Change 187

Core Shutdown Margin

3.3 LIMITING CONDITIONS FOR OPERATION

3.3 CONTROL ROD SYSTEM

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

The core loading shall be limited to that which can be made subcritical in the most reactive condition during the operation cycle with the highest worth, operable control rod in its fully withdrawn position and all other operable rods inserted.

Add INSERT 3.3.A.1

2. Reactivity Margin - Inoperable Control Rods

Control rod driven which cannot be moved with control rod drive pressure shall be considered inoperable. If a partially or fully withdrawn control rod drive cannot be moved with drive or scram pressure, the reactor shall be brought to a shutdown condition within 48 hours unless investigation demonstrates that the cause of the failure is not due to a failed control rod drive mechanism collet housing. The control rod directional control valves for inoperable control rods shall be

4.3 SURVEILLANCE REQUIREMENTS

4.3 CONTROL ROD SYSTEM

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

~~Control rods shall be withdrawn following a refueling outage when core alterations were performed to demonstrate a shutdown margin of 0.25 per cent Δk at any time in the subsequent fuel cycle with the highest worth operable control rod fully withdrawn and all other operable rods inserted.~~

Add INSERT 4.3.A.1

2. Reactivity Margin - Inoperable Control Rods

Each partially or fully withdrawn operable control rod shall be exercised one notch at least once each week. This test shall be performed at least once per 24 hours in the event power operation is continuing with two or more inoperable control rods or in the event power operation is continuing with one fully or partially withdrawn rod which cannot be moved and for which control rod drive mechanism damage has not been ruled out. The surveillance need not be completed within 24 hours if the number

INSERT 3.3.A.1

To ensure this capability, the shutdown margin shall be provided as follows any time there is fuel in the core:

(a) $\geq 0.38\% \ \Delta k/k$ with the highest worth rod analytically determined;

or

(b) $\geq 0.28\% \ \Delta k/k$ with the highest worth rod determined by test.

With the required shutdown margin not met during power operation, either restore the required shutdown margin within 6 hours, or be in hot shutdown within the next 12 hours.

With the required shutdown margin not met and the mode switch in the "Refuel" position, immediately suspend Alteration of the Reactor Core except for control rod insertion and fuel assembly removal; immediately initiate action to fully insert all insertable control rods in core cells containing one or more fuel assemblies; within 1 hour, initiate action to restore the integrity of the secondary containment system.

INSERT 4.3.A.1

Verify that the required SDM is met prior to each in-vessel fuel movement during the fuel loading sequence.

Within 4 hours after criticality following fuel movement within the reactor pressure vessel or control rod replacement, verify the required shutdown margin will be met at any time in the subsequent operation cycle with the highest worth operable control rod fully withdrawn and all other operable rods inserted (except as provided in Specifications 3.12.D and 3.12.E).

3.3 LIMITING CONDITIONS FOR OPERATION

E. Reactivity Anomalies

The reactivity equivalent of the difference between the actual critical rod configuration and the expected configuration during power operation shall not exceed 1% Δk. If this limit is exceeded, the reactor will be shut down until the cause has been determined and corrective actions have been taken if such actions are appropriate.

$\Delta k/k$

F. If Specification 3.3C B through D above are not met, an orderly shutdown shall be initiated and the reactor shall be in the cold shutdown condition within 24 hours.

4.3 SURVEILLANCE REQUIREMENTS

E. Reactivity Anomalies

During the startup test program and startups following refueling outages, the critical rod configurations will be compared to the expected configurations at selected operating conditions. These comparisons will be used as base data for reactivity monitoring during subsequent power operation throughout the fuel cycle. At specific power operating conditions, the critical rod configuration will be compared to the configuration expected based upon appropriately corrected past data. This comparison will be made at least every equivalent full power month.

BASES:

3.3 & 4.3 CONTROL ROD SYSTEM

A. Reactivity Limitations

1. Reactivity Margin - Core Loading

INSERT 89A

~~The core reactivity limitation is a restriction to be applied principally to the design of new fuel which may be loaded in the core or into a particular refueling pattern. Satisfaction of the limitation can only be demonstrated at the time of loading and must be such that it will apply to the entire subsequent fuel cycle. At each refueling the reactivity of the core loading will be limited so the core can be made subcritical by at least R + 0.25% Δk with the highest worth control rod fully withdrawn and all others inserted. The value of R in % Δk is the amount by which the calculated core reactivity, at any time in the operating cycle, exceeds the reactivity at the time of the demonstration. R must be a positive quantity or zero. The value of R shall include the potential shutdown margin loss assuming full B_4C settling in all inverted poison tubes present in the core. The 0.25% Δk is provided as a finite, demonstrable, sub-criticality margin.~~

2. Reactivity Margin - Inoperable Control Rods

Specification 3.3.A.2 requires that a rod be taken out of service if it cannot be moved with drive pressure. If a rod is disarmed electrically, its position shall be consistent with the shutdown reactivity limitation stated in Specification 3.3.A.1. This assures that the core can be shutdown at all times with the remaining control rods, assuming the highest worth operable control rod does rod insert. An allowable pattern for control rods valved out of service will be available to the reactor operator. The number of rods permitted to be inoperable could be many more than the six allowed by the Specification, particularly late in the operation cycle; however, the occurrence of more than six could be indicative of a generic control rod drive problem and the reactor will be shutdown. Also if damage within the control rod drive mechanism and in particular, cracks in drive internal housing, cannot be ruled out, then a generic problem affecting a number of drives cannot be ruled out. Circumferential cracks resulting from stress assisted intergranular corrosion have occurred in the collet housing of drives at several BWRs. This type of cracking could occur in a number of drives and if the cracks propagated until severance of the collet housing occurred, scram could be prevented in the affected rods. Limiting the period of operation with a potentially severed collet housing and requiring increased surveillance after detecting one stuck rod will assure that the reactor will not be operated with a large number of rods with failed collet housings.

B. Control Rods

1. Control rod dropout accidents as discussed in the FSAR can lead to significant core damage. If coupling integrity is maintained, the possibility of a rod dropout accident is eliminated. The overtravel position feature provides a positive check as only uncoupled drives may reach this position. Neutron instrumentation response to rod movement provides a verification that the rod is following its drive.

<u>INSERT 89A</u>

The specified Shutdown Margin (SDM) limit accounts for the uncertainty in the demonstration of SDM by testing. Separate SDM limits are provided for testing where the highest worth control rod is determined analytically or by measurement. This is due to the reduced uncertainty in the SDM test when the highest worth control rod is determined by measurement (e.g., SDM may be demonstrated by an in-sequence control rod withdrawal, in which the highest worth control rod is analytically determined, or by local criticals, where the highest worth rod is determined by testing).

Following a refueling, adequate SDM must be demonstrated to ensure that the reactor can be made subcritical at any point during the cycle. Since core reactivity will vary during the cycle as a function of fuel depletion and poison burnup, the beginning of cycle (BOC) test must also account for changes in core reactivity during the cycle. Therefore, to obtain the SDM, the initial measured value must exceed LCO 3.3.A.1 by an adder, "R", which is the difference between the calculated value of maximum core reactivity during the operating cycle and the calculated BOC core reactivity. If the value of "R" is negative (that is, BOC is the most reactive point in the cycle), no correction to the BOC measured value is required. The value of R shall include the potential shutdown margin loss assuming full B_4C settling in all inverted poison tubes present in the core. The frequency of 4 hours after reaching criticality is allowed to provide a reasonable amount of time to perform the required calculations and have appropriate verification.

When SDM is demonstrated by calculations not associated with a test (e.g., to confirm SDM during the fuel loading sequence), additional margin must be included to account for uncertainties in the calculation. During refueling, adequate SDM is required to ensure that the reactor does not reach criticality during control rod withdrawals. An evaluation of each in-vessel fuel movement during fuel loading (including shuffling fuel within the core) is required to ensure adequate SDM is maintained during refueling. This evaluation ensures that the intermediate loading patterns are bounded by the safety analyses for the final core loading pattern. For example, bounding analyses that demonstrate adequate SDM for the most reactive configurations during the refueling may be performed to demonstrate acceptability of the entire fuel movement sequence. These bounding analyses include additional margins to account for the associated uncertainties in the calculation.

BASES: 3.3 & 4.3 (Cont'd)

7. Periodic verification that the Scram Discharge Volume (SDV) drain and vent valves are maintained in the open position provides assurance that the SDV will be available to accept the water displaced from the control rod drives in the event of a scram.

C. Scram Insertion Times

The Control Rod System is designed to bring the reactor subcritical at a rate fast enough to prevent fuel damage. The limiting power transient is that resulting from a turbine stop valve closure with a failure of the Turbine Bypass System. Analysis of this transient shows that the negative reactivity rates resulting from the scram with the average response of all the drives as given in the above specification, provide the required protection, and MCPR remains greater than the fuel cladding integrity safety limit.

The scram times for all control rods shall be determined during each operating cycle. The weekly control rod exercise test serves as a periodic check against deterioration of the Control Rod System and also verifies the ability of the control rod drive to scram. The frequency of exercising the control rods under the conditions of two or more control rods valved out of service provides even further assurance of the reliability of the remaining control rods.

D. Control Rod Accumulators

Requiring no more than one inoperable accumulator in any nine-rod (3x3) square array is based on a series of XY PDQ-4 quarter core calculations of a cold, clean core. The worst case in a nine-rod withdrawal sequence resulted in a $K_{eff} \leq 1.0$. Other repeating rod sequences with more rods withdrawn resulted in $K_{eff} \geq 1.0$. At reactor pressures in excess of 800 psig, even those control rods with inoperable accumulators will be able to meet required scram insertion times due to the action of reactor pressure. In addition, they may be normally inserted using the Control-Rod-Drive Hydraulic System. Procedural control will assure that control rods with inoperable accumulators will be spaced in a one-in-nine array rather than grouped together.

E. Reactivity Anomalies

During each fuel cycle, excess operating reactivity varies as fuel depletes and as any burnable poison in supplementary control is burned. The magnitude of this excess reactivity may be inferred from the critical rod configuration. As fuel burnup progresses, anomalous behavior in the excess reactivity may be detected by comparison of the critical rod pattern selected base states to the predicted rod inventory at that state. Power operation base conditions provide the most sensitive and directly interpretable data relative to core reactivity. Furthermore, using power operating base conditions permits frequent reactivity comparisons. Requiring a reactivity comparison at the specified frequency assures that a comparison will be made before the core reactivity change exceeds 1% ΔK. Deviations in core reactivity greater than 1% ΔK are not expected and require thorough evaluation. One percent reactivity limit is considered safe since an insertion of the reactivity into the core would not lead to transients exceeding design conditions of the Reactor System.

$\Delta K/K$

3.12 LIMITING CONDITIONS FOR OPERATION	4.12 SURVEILLANCE REQUIREMENTS

3.12 D. Control Rod and Control Rod Drive Maintenance

~~A maximum of two~~ One ~~non-adjacent control rods separated by more than two control cells in any direction~~ may be withdrawn from the core for the purpose of performing control rod and/or control rod drive maintenance provided the following conditions are satisfied:

1. The reactor mode switch shall be locked in the "Refuel" position. ~~The refueling interlock which prevents more than one control rod from being withdrawn may be bypassed for one of the control rods on which maintenance is being performed. All other~~ refueling interlocks shall be operable.

2. Specification 3.3.A.1 shall be met, or the control rod directional control valves for a minimum of eight control rods surrounding ~~each~~ the drive out of service for maintenance shall be disarmed electrically and sufficient margin to criticality demonstrated.

3. SRMs shall the be operable ~~(a)~~ in ~~each~~ core quadrant containing ~~a~~ the control rod on which maintenance is being performed, and ~~(b)~~ in an adjacent quadrant. ~~adjacent to one of the quadrants sp[illegible]fied in Sp[illegible]cation 3.1[illegible] (a) above.~~ The Requirements for an SRM to be considered operable are given in Specification 3.12.B.

4.12 D. Control Rod and Control Rod Drive Maintenance

1. ~~Sufficient control rods shall be withdrawn prior to performing this maintenance to demonstrate with a margin of 0.25 percent Δk~~ that the core can be made subcritical at any time during the maintenance with the strongest operable control rod fully withdrawn and all other operable rods fully inserted.

2. Alternately, if a minimum of eight control rods surrounding ~~each~~ the control rod out of service for maintenance are to be fully inserted and have their directional control valves electrically disarmed, the shutdown ~~0.25 percent Δk~~ margin shall be met with the strongest control rod remaining in service during the maintenance period fully withdrawn.

Prior to performing this maintenance, core shutdown margin shall be determined in accordance with Specification 3.3.A.1 to ensure ....

3.12 LIMITING CONDITIONS FOR OPERATION

E. Extended Core Maintenance

One or more ~~More than two~~ control rods may be withdrawn or removed from the reactor core provided the following conditions are satisfied:

1. The reactor mode switch shall be locked in the "Refuel" position. The refueling interlock which prevents more than one control rod from being withdrawn may be bypassed on a withdrawn control rod after the fuel assemblies in the cell containing (controlled by) that control rod have been removed from the reactor core. All other refueling interlocks shall be operable.

2. SRMs shall be operable in the core quadrant where fuel or control rods are being moved, and in an adjacent quadrant. The requirements for an SRM to be considered operable are given in Specification 3.12.B.

3. If the spiral unload/reload method of core alteration is to be used, the following conditions shall be met:

   a. Prior to spiral unload and reload, the SRMs shall be proven operable as stated in Specification 3.12.B1 and 3.12.B2. However, during spiral unloading, the count rate may drop below 3 cps.

4.12 SURVEILLANCE REQUIREMENTS

E. Extended Core Maintenance

Prior to control rod withdrawal for extended core maintenance, that control rods control cell shall be verified to contain no fuel assemblies.

1. This surveillance requirement is the same as that given in Specification 4.12.A.

2. This surveillance requirement is the same as that given in Specification 4.12.B.

BASES: 3.12 & 4.12 (Cont'd)

C. To assure that there is adequate water to shield and cool the irradiated fuel assemblies stored in the pool, a minimum pool water level is established. This minimum water level of 36 feet is established because it would be a significant change from the normal level, well above a level to assure adequate cooling (just above active fuel).

D. During certain periods, it is desirable to perform maintenance on a single ~~two~~ control rod~~s~~ and/or control rod drive~~s~~ ~~at the same time~~. This specification provides assurance that inadvertent criticality does not occur during such maintenance.

The maintenance is performed with the mode switch in the "Refuel" position to provide the refueling interlocks normally available during refueling operations as explained in Part A of these Bases. INSERT 23BA ~~In order to withdraw a second control rod after withdrawal of the first rod, it is necessary to bypass the refueling interlock on the first control rod which prevents more than one control rod from being withdrawn at the same time.~~ The requirement that an adequate shutdown margin be ~~demonstrated~~ determined with the control rods remaining in service ensures that inadvertent criticality cannot occur during this maintenance. ~~The shutdown margin is verified by demonstrating that the core is shut down even if the strongest control rod remaining in service is fully withdrawn.~~ Disarming the directional control valves does not inhibit control rod scram capability.

E. The intent of this specification is to permit the unloading of a ~~significant~~ portion of the reactor core for such purposes as inservice inspection requirements, examination of the core support plate, control rod or control rod drive maintenance, etc. This specification provides assurance that inadvertent criticality does not occur during such operation.

This operation is performed with the mode switch in the "Refuel" position to provide the refueling interlocks normally available during refueling as explained in the Bases for Specification 3.12.A. In order to withdraw more than one control rod, it is necessary to bypass the refueling interlock on each withdrawn control rod which prevents more than one control rod from being withdrawn at a time. The requirement that the fuel assemblies in the cell controlled by the control rod be removed from the reactor core before the interlock can be bypassed ensures that withdrawal of another control rod does not result in inadvertent criticality. Each control rod essentially provides reactivity control for the fuel assemblies in the cell associated with that control rod. Thus, removal of an entire cell (fuel assemblies plus control rod) results in a lower reactivity potential of the core.

One method available for unloading or reloading the core is the spiral unload/reload. A spiral unloading pattern is one by which the fuel in the outermost cells (four fuel bundles surrounding a control rod) is removed first. Unloading continues by unloading the remaining outermost fuel by cell spiralling inward towards the center cell which is the last cell removed. Spiral reloading is reverse of unloading, with the exception that two (2) diagonally adjacent bundles, which have previously accumulated exposure in-core, are placed next to each of the 4 SRMs before the actual spiral reloading begins. The spiral reload then begins in the center cell and spirals outward until the core is fully loaded.

INSERT 238A

Refueling interlocks restrict the movement of control rods and the operation of the refueling equipment to reinforce operational procedures that prevent the reactor from becoming critical during refueling operations. During refueling operations, no more than one control rod is permitted to be withdrawn from a core cell containing one or more fuel assemblies. The refueling interlocks use the "full-in" position indicators to determine the position of all control rods. If the "full-in" position signal is not present for every control rod, then the "all-rods-in" permissive for the refueling equipment interlocks is not present and fuel loading and control rod withdrawal is prevented. The refuel position one-rod-out interlock will not allow the withdrawal of a second control rod.

New Technical Specification Pages

Proposed Change 187

Core Shutdown Margin

3.3 LIMITING CONDITIONS FOR OPERATION

3.3 CONTROL ROD SYSTEM

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

The core loading shall be limited to that which can be made subcritical in the most reactive condition during the operation cycle with the highest worth, operable control rod in its fully withdrawn position and all other operable rods inserted.

To ensure this capability, the shutdown margin shall be provided as follows any time there is fuel in the core:

(a) $\geq$0.38% $\Delta k/k$ with the highest worth rod analytically determined;

or

(b) $\geq$0.28% $\Delta k/k$ with the highest worth rod determined by test.

With the required shutdown margin not met during power operation, either restore the required shutdown margin within 6 hours, or be in hot shutdown within the next 12 hours.

4.3 SURVEILLANCE REQUIREMENTS

4.3 CONTROL ROD SYSTEM

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

Verify that the required SDM is met prior to each in-vessel fuel movement during the fuel loading sequence.

Within 4 hours after criticality following fuel movement within the reactor pressure vessel or control rod replacement, verify the required shutdown margin will be met at any time in the subsequent operation cycle with the highest worth operable control rod fully withdrawn and all other operable rods inserted (except as provided in Specifications 3.12.D and 3.12.E).

3.3 LIMITING CONDITIONS FOR OPERATION

With the required shutdown margin not met and the mode switch in the "Refuel" position, immediately suspend Alteration of the Reactor Core except for control rod insertion and fuel assembly removal; immediately initiate action to fully insert all insertable control rods in core cells containing one or more fuel assemblies; within 1 hour, initiate action to restore the integrity of the Secondary Containment System.

2. Reactivity Margin - Inoperable Control Rods

Control rod driven which cannot be moved with control rod drive pressure shall be considered inoperable. If a partially or fully withdrawn control rod drive cannot be moved with drive or scram pressure, the reactor shall be brought to a shutdown condition within 48 hours unless investigation demonstrates that the cause of the failure is not due to a failed control rod drive mechanism collet housing. The control rod directional control valves for inoperable control rods shall be

4.3 SURVEILLANCE REQUIREMENTS

2. Reactivity Margin - Inoperable Control Rods

Each partially or fully withdrawn operable control rod shall be exercised one notch at least once each week. This test shall be performed at least once per 24 hours in the event power operation is continuing with two or more inoperable control rods or in the event power operation is continuing with one fully or partially withdrawn rod which cannot be moved and for which control rod drive mechanism damage has not been ruled out. The surveillance need not be completed within 24 hours if the number

3.3 LIMITING CONDITIONS FOR OPERATION

E. Reactivity Anomalies

The reactivity equivalent of the difference between the actual critical rod configuration and the expected configuration during power operation shall not exceed 1% $\Delta k/k$. If this limit is exceeded, the reactor will be shut down until the cause has been determined and corrective actions have been taken if such actions are appropriate.

F. If Specification 3.3B through D above are not met, an orderly shutdown shall be initiated and the reactor shall be in the cold shutdown condition within 24 hours.

4.3 SURVEILLANCE REQUIREMENTS

E. Reactivity Anomalies

During the startup test program and startups following refueling outages, the critical rod configurations will be compared to the expected configurations at selected operating conditions. These comparisons will be used as base data for reactivity monitoring during subsequent power operation throughout the fuel cycle. At specific power operating conditions, the critical rod configuration will be compared to the configuration expected based upon appropriately corrected past data. This comparison will be made at least every equivalent full power month.

BASES:

3.3 & 4.3 CONTROL ROD SYSTEM

A. Reactivity Limitations

1. Reactivity Margin - Core Loading

The specified shutdown margin (SDM) limit accounts for the uncertainty in the demonstration of SDM by testing. Separate SDM limits are provided for testing where the highest worth control rod is determined analytically or by measurement. This is due to the reduced uncertainty in the SDM test when the highest worth control rod is determined by measurement (e.g., SDM may be demonstrated by an in-sequence control rod withdrawal, in which the highest worth control rod is analytically determined, or by local criticals, where the highest worth rod is determined by testing).

Following a refueling, adequate SDM must be demonstrated to ensure that the reactor can be made subcritical at any point during the cycle. Since core reactivity will vary during the cycle as a function of fuel depletion and poison burnup, the beginning of cycle (BOC) test must also account for changes in core reactivity during the cycle. Therefore, to obtain the SDM, the initial measured value must exceed LCO 3.3.A.1 by an adder, "R", which is the difference between the calculated value of maximum core reactivity during the operating cycle and the calculated BOC core reactivity. If the value of "R" is negative (that is, BOC is the most reactive point in the cycle), no correction to the BOC measured value is required. The value of R shall include the potential shutdown margin loss assuming full B_4C settling in all inverted poison tubes present in the core. The frequency of 4 hours after reaching criticality is allowed to provide a reasonable amount of time to perform the required calculations and have appropriate verification.

When SDM is demonstrated by calculations not associated with a test (e.g., to confirm SDM during the fuel loading sequence), additional margin must be included to account for uncertainties in the calculation. During refueling, adequate SDM is required to ensure that the reactor does not reach criticality during control rod withdrawals. An evaluation of each in-vessel fuel movement during fuel loading (including shuffling fuel within the core) is required to ensure adequate SDM is maintained during refueling. This evaluation ensures that the intermediate loading patterns are bounded by the safety analyses for the final core loading pattern. For example, bounding analyses that demonstrate adequate SDM for the most reactive configurations during the refueling may be performed to demonstrate acceptability of the entire fuel movement sequence. These bounding analyses include additional margins to account for the associated uncertainties in the calculation.

2. Reactivity Margin - Inoperable Control Rods

Specification 3.3.A.2 requires that a rod be taken out of service if it cannot be moved with drive pressure. If a rod is disarmed electrically, its position shall be consistent with the shutdown reactivity limitation stated in Specification 3.3.A.1. This assures that the core can be shutdown at all times with the remaining control rods, assuming the highest worth, operable control rod does rod insert. An allowable pattern for control rods valved out of service will be available to the reactor operator. The number of rods permitted to be inoperable could be

BASES: 3.3 & 4.3 (Cont'd)

many more than the six allowed by the Specification, particularly late in the operation cycle; however, the occurrence of more than six could be indicative of a generic control rod drive problem and the reactor will be shutdown. Also if damage within the control rod drive mechanism and in particular, cracks in drive internal housing, cannot be ruled out, then a generic problem affecting a number of drives cannot be ruled out. Circumferential cracks resulting from stress assisted intergranular corrosion have occurred in the collet housing of drives at several BWRs. This type of cracking could occur in a number of drives and if the cracks propagated until severance of the collet housing occurred, scram could be prevented in the affected rods. Limiting the period of operation with a potentially severed collet housing and requiring increased surveillance after detecting one stuck rod will assure that the reactor will not be operated with a large number of rods with failed collet housings.

B. Control Rods

1. Control rod dropout accidents as discussed in the FSAR can lead to significant core damage. If coupling integrity is maintained, the possibility of a rod dropout accident is eliminated. The overtravel position feature provides a positive check as only uncoupled drives may reach this position. Neutron instrumentation response to rod movement provides a verification that the rod is following its drive.

BASES: 3.3 & 4.3 (Cont'd)

7. Periodic verification that the Scram Discharge Volume (SDV) drain and vent valves are maintained in the open position provides assurance that the SDV will be available to accept the water displaced from the control rod drives in the event of a scram.

C. Scram Insertion Times

The Control Rod System is designed to bring the reactor subcritical at a rate fast enough to prevent fuel damage. The limiting power transient is that resulting from a turbine stop valve closure with a failure of the Turbine Bypass System. Analysis of this transient shows that the negative reactivity rates resulting from the scram with the average response of all the drives as given in the above specification, provide the required protection, and MCPR remains greater than the fuel cladding integrity safety limit.

The scram times for all control rods shall be determined during each operating cycle. The weekly control rod exercise test serves as a periodic check against deterioration of the Control Rod System and also verifies the ability of the control rod drive to scram. The frequency of exercising the control rods under the conditions of two or more control rods valved out of service provides even further assurance of the reliability of the remaining control rods.

D. Control Rod Accumulators

Requiring no more than one inoperable accumulator in any nine-rod (3x3) square array is based on a series of XY PDQ-4 quarter core calculations of a cold, clean core. The worst case in a nine-rod withdrawal sequence resulted in a $K_{eff} \leq 1.0$. Other repeating rod sequences with more rods withdrawn resulted in $K_{eff} \geq 1.0$. At reactor pressures in excess of 800 psig, even those control rods with inoperable accumulators will be able to meet required scram insertion times due to the action of reactor pressure. In addition, they may be normally inserted using the Control-Rod-Drive Hydraulic System. Procedural control will assure that control rods with inoperable accumulators will be spaced in a one-in-nine array rather than grouped together.

E. Reactivity Anomalies

During each fuel cycle, excess operating reactivity varies as fuel depletes and as any burnable poison in supplementary control is burned. The magnitude of this excess reactivity may be inferred from the critical rod configuration. As fuel burnup progresses, anomalous behavior in the excess reactivity may be detected by comparison of the critical rod pattern selected base states to the predicted rod inventory at that state. Power operation base conditions provide the most sensitive and directly interpretable data relative to core reactivity. Furthermore, using power operating base conditions permits frequent reactivity comparisons. Requiring a reactivity comparison at the specified frequency assures that a comparison will be made before the core reactivity change exceeds 1% $\Delta k/k$. Deviations in core reactivity greater than 1% $\Delta k/k$ are not expected and require thorough evaluation. One percent reactivity limit is considered safe since an insertion of the reactivity into the core would not lead to transients exceeding design conditions of the Reactor System.

3.12 LIMITING CONDITIONS FOR OPERATION

D. Control Rod and Control Rod Drive Maintenance

One control rod may be withdrawn from the core for the purpose of performing control rod and/or control rod drive maintenance provided the following conditions are satisfied:

1. The reactor mode switch shall be locked in the "Refuel" position. All refueling interlocks shall be operable.

2. Specification 3.3.A.1 shall be met, or the control rod directional control valves for a minimum of eight control rods surrounding the drive out of service for maintenance shall be disarmed electrically and sufficient margin to criticality demonstrated.

3. SRMs shall be operable in the core quadrant containing the control rod on which maintenance is being performed and in an adjacent quadrant. The requirements for an SRM to be considered operable are given in Specification 3.12.B.

4.12 SURVEILLANCE REQUIREMENTS

D. Control Rod and Control Rod Drive Maintenance

1. Prior to performing this maintenance, core shutdown margin shall be determined in accordance with Specification 3.3.A.1 to ensure that the core can be made subcritical at any time during the maintenance with the strongest operable control rod fully withdrawn and all other operable rods fully inserted.

2. Alternately, if a minimum of eight control rods surrounding the control rod out of service for maintenance are to be fully inserted and have their directional control valves electrically disarmed, the shutdown margin shall be met with the strongest control rod remaining in service during the maintenance period fully withdrawn.

3.12 LIMITING CONDITIONS FOR OPERATION

E. Extended Core Maintenance

One or more control rods may be withdrawn or removed from the reactor core provided the following conditions are satisfied:

1. The reactor mode switch shall be locked in the "Refuel" position. The refueling interlock which prevents more than one control rod from being withdrawn may be bypassed on a withdrawn control rod after the fuel assemblies in the cell containing (controlled by) that control rod have been removed from the reactor core. All other refueling interlocks shall be operable.

2. SRMs shall be operable in the core quadrant where fuel or control rods are being moved, and in an adjacent quadrant. The requirements for an SRM to be considered operable are given in Specification 3.12.B.

3. If the spiral unload/reload method of core alteration is to be used, the following conditions shall be met:

   a. Prior to spiral unload and reload, the SRMs shall be proven operable as stated in Specification 3.12.B1 and 3.12.B2. However, during spiral unloading, the count rate may drop below 3 cps.

4.12 SURVEILLANCE REQUIREMENTS

E. Extended Core Maintenance

Prior to control rod withdrawal for extended core maintenance, that control rods control cell shall be verified to contain no fuel assemblies.

1. This surveillance requirement is the same as that given in Specification 4.12.A.

2. This surveillance requirement is the same as that given in Specification 4.12.B.

BASES: 3.12 & 4.12 (Cont'd)

C. To assure that there is adequate water to shield and cool the irradiated fuel assemblies stored in the pool, a minimum pool water level is established. This minimum water level of 36 feet is established because it would be a significant change from the normal level, well above a level to assure adequate cooling (just above active fuel).

D. During certain periods, it is desirable to perform maintenance on a single control rod and/or control rod drive. This specification provides assurance that inadvertent criticality does not occur during such maintenance.

The maintenance is performed with the mode switch in the "Refuel" position to provide the refueling interlocks normally available during refueling operations as explained in Part A of these Bases. Refueling interlocks restrict the movement of control rods and the operation of the refueling equipment to reinforce operational procedures that prevent the reactor from becoming critical during refueling operations. During refueling operations, no more than one control rod is permitted to be withdrawn from a core cell containing one or more fuel assemblies. The refueling interlocks use the "full-in" position indicators to determine the position of all control rods. If the "full-in" position signal is not present for every control rod, then the "all-rods-in" permissive for the refueling equipment interlocks is not present and fuel loading and control rod withdrawal is prevented. The refuel position one-rod-out interlock will not allow the withdrawal of a second control rod. The requirement that an adequate shutdown margin be determined with the control rods remaining in service ensures that inadvertent criticality cannot occur during this maintenance. Disarming the directional control valves does not inhibit control rod scram capability.

E. The intent of this specification is to permit the unloading of a portion of the reactor core for such purposes as inservice inspection requirements, examination of the core support plate, control rod, control rod drive maintenance, etc. This specification provides assurance that inadvertent criticality does not occur during such operation.

This operation is performed with the mode switch in the "Refuel" position to provide the refueling interlocks normally available during refueling as explained in the Bases for Specification 3.12.A. In order to withdraw more than one control rod, it is necessary to bypass the refueling interlock on each withdrawn control rod which prevents more than one control rod from being withdrawn at a time. The requirement that the fuel assemblies in the cell controlled by the control rod be removed from the reactor core before the interlock can be bypassed ensures that withdrawal of another control rod does not result in inadvertent criticality. Each control rod essentially provides reactivity control for the fuel assemblies in the cell associated with that control rod. Thus, removal of an entire cell (fuel assemblies plus control rod) results in a lower reactivity potential of the core.

One method available for unloading or reloading the core is the spiral unload/reload. A spiral unloading pattern is one by which the fuel in the outermost cells (four fuel bundles surrounding a control rod) is removed first. Unloading continues by unloading the remaining outermost fuel by cell spiralling inward towards the center cell which is the last cell removed. Spiral reloading is reverse of unloading, with the exception that two (2) diagonally adjacent bundles, which have previously accumulated exposure in-core, are placed next to each of the 4 SRMs before the actual spiral reloading begins. The spiral reload then begins in the center cell and spirals outward until the core is fully loaded.