

## REACTIVITY CONTROL SYSTEMS

SHUTDOWN MARGIN -  $T_{avg}$  LESS THAN OR EQUAL TO 200°F

### LIMITING CONDITION FOR OPERATION

3.1.1.2 The SHUTDOWN MARGIN shall be greater than or equal to 2.0% delta k/k.

APPLICABILITY: MODE 5.

#### ACTION:

With the SHUTDOWN MARGIN less than 2.0% delta k/k, immediately initiate and continue boration at greater than or equal to 40 gpm of a solution containing greater than or equal to 1720 ppm boron or equivalent until the required SHUTDOWN MARGIN is restored.

### SURVEILLANCE REQUIREMENTS

4.1.1.2 The SHUTDOWN MARGIN shall be determined to be greater than or equal to 2.0% delta k/k:

- a. Within one hour after detection of an inoperable CEA(s) and at least once per 12 hours thereafter while the CEA(s) is inoperable. If the inoperable CEA is immovable or untrippable, the above required SHUTDOWN MARGIN shall be increased by an amount at least equal to the withdrawn worth of the immovable or untrippable CEA(s).
- b. At least once per 24 hours by consideration of the following factors:
  1. Reactor coolant system boron concentration,
  2. CEA position,
  3. Reactor coolant system average temperature,
  4. Fuel burnup based on gross thermal energy generation,
  5. Xenon concentration, and
  6. Samarium concentration.

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### 3/4.1 REACTIVITY CONTROL SYSTEMS

#### BASES

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#### 3/4.1.1 BORATION CONTROL

##### 3/4.1.1.1 and 3/4.1.1.2 SHUTDOWN MARGIN

A sufficient SHUTDOWN MARGIN ensures that 1) the reactor can be made subcritical from all operating conditions, 2) the reactivity transients associated with postulated accident conditions are controllable within acceptable limits, and 3) the reactor will be maintained sufficiently subcritical to preclude inadvertent criticality in the shutdown condition.

SHUTDOWN MARGIN requirements vary throughout core life as a function of fuel depletion, RCS boron concentration, and RCS  $T_{avg}$ . The most restrictive condition occurs at EDL, with  $T_{avg}$  at no load operating temperature, and is associated with a postulated steam line break accident and resulting uncontrolled RCS cooldown. In the analysis of this accident, a minimum SHUTDOWN MARGIN of 5.15% delta k/k is required to control the reactivity transient. Accordingly, the SHUTDOWN MARGIN requirement is based upon this limiting condition and is consistent with FSAR safety analysis assumptions. With  $T_{avg}$  less than or equal to 200°F, the reactivity transients resulting from any postulated accident are minimal and a 2% delta k/k shutdown margin provides adequate protection.

##### 3/4.1.1.3 MODERATOR TEMPERATURE COEFFICIENT

The limitations on moderator temperature coefficient (MTC) are provided to ensure that the assumptions used in the accident and transient analysis remain valid through each fuel cycle. The surveillance requirements for measurement of the MTC during each fuel cycle are adequate to confirm the MTC value since this coefficient changes slowly due principally to the reduction in RCS boron concentration associated with fuel burnup. The confirmation that the measured MTC value is within its limit provides assurances that the coefficient will be maintained within acceptable values throughout each fuel cycle.

## REACTIVITY CONTROL SYSTEMS

### FLOW PATHS - OPERATING

#### LIMITING CONDITION FOR OPERATION

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3.1.2.2 At least two of the following boron injection flow paths and one associated heat tracing circuit shall be OPERABLE:

- a. Flow paths from one or both boric acid makeup tanks via
  1. The associated gravity feed connection(s) and/or
  2. The associated boric acid makeup pump(s)via charging pump(s) to the RCS  
and/or
- b. The flow path from the refueling water storage tank via charging pump(s) to the Reactor Coolant System.

APPLICABILITY: MODES 1, 2, 3 and 4.

#### ACTION:

With only one of the above required boron injection flow paths to the Reactor Coolant System OPERABLE, restore at least two boron injection flow paths to the Reactor Coolant System to OPERABLE status within 72 hours or be in at least HOT STANDBY and borated to a SHUTDOWN MARGIN equivalent to at least  $2\% \Delta k/k$  at 200°F within the next 6 hours; restore at least two flow paths to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.

#### SURVEILLANCE REQUIREMENTS

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4.1.2.2 At least two of the above required flow paths shall be demonstrated OPERABLE:

- a. At least once per 7 days by verifying that the temperature of the heat traced portion of the flow path from the boric acid makeup tanks is above the temperature limit line shown on Figure 3.1-1.
- b. At least once per 31 days by verifying that each valve (manual, power operated or automatic) in the flow path that is not locked, sealed, or otherwise secured in position, is in its correct position.
- c. At least once per 18 months during shutdown by verifying that each automatic valve in the flow path actuates to its correct position on a SIAS test signal.
- d. At least once per 18 months by verifying that the flow path required by Specification 3.1.2.2.a delivers at least 40 gpm to the Reactor Coolant System.

## REACTIVITY CONTROL SYSTEMS

### CHARGING PUMPS - OPERATING

#### LIMITING CONDITION FOR OPERATION

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3.1.2.4 At least two charging pumps shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

With only one charging pump OPERABLE, restore at least two charging pumps to OPERABLE status within 72 hours or be in at least HOT STANDBY and borated to a SHUTDOWN MARGIN equivalent to at least 2% delta k/k at 200°F within the next 6 hours; restore at least two charging pumps to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.

#### SURVEILLANCE REQUIREMENTS

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4.1.2.4 No additional Surveillance Requirements other than those required by Specification 4.0.5.

## REACTIVITY CONTROL SYSTEMS

### BORIC ACID MAKEUP PUMPS - OPERATING

#### LIMITING CONDITION FOR OPERATION

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3.1.2.6 At least the boric acid makeup pump(s) in the boron injection flow path(s) required OPERABLE pursuant to Specification 3.1.2.2a shall be OPERABLE and capable of being powered from an OPERABLE emergency bus if the flow path through the boric acid pump(s) in Specification 3.1.2.2a is OPERABLE.

APPLICABILITY: MODES 1, 2, 3 and 4.

#### ACTION:

With one boric acid makeup pump required for the boron injection flow path(s) pursuant to Specification 3.1.2.2a inoperable, restore the boric acid makeup pump to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and borated to a SHUTDOWN MARGIN equivalent to at least 2% delta k/k at 200°F; restore the above required boric acid makeup pump(s) to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.

#### SURVEILLANCE REQUIREMENTS

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4.1.2.6 No additional Surveillance Requirements other than those required by Specification 4.0.5.

## REACTIVITY CONTROL SYSTEMS

### BORATED WATER SOURCES - OPERATING

#### LIMITING CONDITION FOR OPERATION

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- 3.1.2.8 Each of the following borated water sources shall be OPERABLE:
- a. At least one boric acid makeup tank and at least one associated heat tracing circuit with the contents of the tanks in accordance with Figure 3.1-1, and
  - b. The refueling water storage tank with:
    1. A minimum contained borated water volume of 362,800 gallons above the ECCS suction connection,
    2. Between 1720 and 2300 ppm of boron, and
    3. A solution temperature between 40°F and 100°F.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

- a. With the above required boric acid makeup tank inoperable, restore the tank to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and borated to a SHUTDOWN MARGIN equivalent to at least 2% delta k/k at 200°F; restore the above required boric acid makeup tank to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.
- b. With the refueling water tank inoperable, restore the tank to OPERABLE status within one hour or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

#### SURVEILLANCE REQUIREMENTS

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- 4.1.2.8 Each borated water sources shall be demonstrated OPERABLE:
- a. At least once per 7 days by:
    1. Verifying the boron concentration in the water,
    2. Verifying the contained borated water volume of the water source, and
    3. Verifying the boric acid makeup tank solution temperature.
  - b. At least once per 24 hours by verifying the RWST temperature when the outside air temperature is less than 40°F or greater than 100°F.

## REACTIVITY CONTROL SYSTEMS

### BASES

#### 3/4.1.1.4 MINIMUM TEMPERATURE FOR CRITICALITY

This specification ensures that the reactor will not be made critical with the Reactor Coolant System average temperature less than 520°F. This limitation is required to ensure 1) the moderator temperature coefficient is within its analyzed temperature range, 2) the protective instrumentation is within its normal operating range, 3) the pressurizer is capable of being in an OPERABLE status with a steam bubble, and 4) the reactor pressure vessel is above its minimum RT<sub>NDT</sub> temperature.

#### 3/4.1.2 BORATION SYSTEMS

The boron injection system ensures that negative reactivity control is available during each mode of facility operation. The components required to perform this function include 1) borated water sources, 2) charging pumps, 3) separate flow paths, 4) boric acid makeup pumps, 5) associated heat tracing systems, and 6) an emergency power supply from OPERABLE diesel generators.

With the RCS average temperature above 200°F, a minimum of two separate and redundant boron injection systems are provided to ensure single functional capability in the event an assumed failure renders one of the systems inoperable. Allowable out-of-service periods ensure that minor component repair or corrective action may be completed without undue risk to overall facility safety from injection system failures during the repair period.

The boration capability of either system is sufficient to provide a SHUTDOWN MARGIN from expected operating conditions of 2.0% delta k/k after xenon decay and cooldown to 200°F. The maximum expected boration capability requirement occurs at EOL from full power equilibrium xenon conditions and requires boric acid solution from the boric acid makeup tanks in the allowable concentrations and volumes of Specification 3.1.2.8 or 53,500 gallons of 1720 ppm borated water from the refueling water tank. However, for the purpose of consistency the minimum required volume of 362,800 gallons above ECCS suction connection in Specification 3.1.2.8 is identical to the more restrictive value of Specification 3.5.4.

With the RCS temperature below 200°F one injection system is acceptable without single failure consideration on the basis of the stable reactivity condition of the reactor and the additional restrictions prohibiting CORE ALTERATIONS and positive reactivity changes in the event the single injection system becomes inoperable.

The boron capability required below 200°F is based upon providing a 2% delta k/k SHUTDOWN MARGIN after xenon decay and cooldown from 200°F to 140°F. This condition requires either 5465 gallons of 1720 ppm borated water from the refueling water tank or boric acid solution from the boric acid makeup tanks in accordance with the requirements of Specification 3.1.2.7.

ATTACHMENT B

## REACTIVITY CONTROL SYSTEMS

SHUTDOWN MARGIN -  $T_{avg}$  LESS THAN OR EQUAL TO 200°F

### LIMITING CONDITION FOR OPERATION

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3.1.1.2 The SHUTDOWN MARGIN shall be greater than or equal to 2.0% delta k/k.

APPLICABILITY: MODE 5.

#### ACTION:

With the SHUTDOWN MARGIN less than 2.0% delta k/k, immediately initiate and continue boration at greater than or equal to 40 gpm of a solution containing greater than or equal to 1720 ppm boron or equivalent until the required SHUTDOWN MARGIN is restored.

### SURVEILLANCE REQUIREMENTS

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4.1.1.2 The SHUTDOWN MARGIN shall be determined to be greater than or equal to 2.0% delta k/k:

- a. Within one hour after detection of an inoperable CEA(s) and at least once per 12 hours thereafter while the CEA(s) is inoperable. If the inoperable CEA is immovable or untrippable, the above required SHUTDOWN MARGIN shall be increased by an amount at least equal to the withdrawn worth of the immovable or untrippable CEA(s).
- b. At least once per 24 hours by consideration of the following factors:
  1. Reactor coolant system boron concentration,
  2. CEA position,
  3. Reactor coolant system average temperature,
  4. Fuel burnup based on gross thermal energy generation,
  5. Xenon concentration, and
  6. Samarium concentration.

### 3/4.1 REACTIVITY CONTROL SYSTEMS

#### BASES

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#### 3/4.1.1 BORATION CONTROL

##### 3/4.1.1.1 and 3/4.1.1.2 SHUTDOWN MARGIN

A sufficient SHUTDOWN MARGIN ensures that 1) the reactor can be made subcritical from all operating conditions, 2) the reactivity transients associated with postulated accident conditions are controllable within acceptable limits, and 3) the reactor will be maintained sufficiently subcritical to preclude inadvertent criticality in the shutdown condition.

SHUTDOWN MARGIN requirements vary throughout core life as a function of fuel depletion, RCS boron concentration, and RCS  $T_{avg}$ . The most restrictive condition occurs at EOL, with  $T_{avg}$  at no load operating temperature, and is associated with a postulated steam line break accident and resulting uncontrolled RCS cooldown. In the analysis of this accident, a minimum SHUTDOWN MARGIN of 5.15% delta k/k is required to control the reactivity transient. Accordingly, the SHUTDOWN MARGIN requirement is based upon this limiting condition and is consistent with FSAR safety analysis assumptions. With  $T_{avg}$  less than or equal to 200°F, the reactivity transients resulting from any postulated accident are minimal and a 2% delta k/k shutdown margin provides adequate protection.

##### 3/4.1.1.3 MODERATOR TEMPERATURE COEFFICIENT

The limitations on moderator temperature coefficient (MTC) are provided to ensure that the assumptions used in the accident and transient analysis remain valid through each fuel cycle. The surveillance requirements for measurement of the MTC during each fuel cycle are adequate to confirm the MTC value since this coefficient changes slowly due principally to the reduction in RCS boron concentration associated with fuel burnup. The confirmation that the measured MTC value is within its limit provides assurances that the coefficient will be maintained within acceptable values throughout each fuel cycle.

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## REACTIVITY CONTROL SYSTEMS

### FLOW PATHS - OPERATING

#### LIMITING CONDITION FOR OPERATION

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3.1.2.2 At least two of the following boron injection flow paths and one associated heat tracing circuit shall be OPERABLE:

a. Flow paths from one or both boric acid makeup tanks via

1. The associated gravity feed connection(s) and/or

2. The associated boric acid makeup pump(s)

via charging pump(s) to the RCS

and/or

b. The flow path from the refueling water storage tank via charging pump(s) to the Reactor Coolant System.

APPLICABILITY: MODES 1, 2, 3 and 4.

#### ACTION:

With only one of the above required boron injection flow paths to the Reactor Coolant System OPERABLE, restore at least two boron injection flow paths to the Reactor Coolant System to OPERABLE status within 72 hours or be in at least HOT STANDBY and borated to a SHUTDOWN MARGIN equivalent to at least 2% delta k/k at 200°F within the next 6 hours; restore at least two flow paths to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.

#### SURVEILLANCE REQUIREMENTS

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4.1.2.2 At least two of the above required flow paths shall be demonstrated OPERABLE:

- a. At least once per 7 days by verifying that the temperature of the heat traced portion of the flow path from the boric acid makeup tanks is above the temperature limit line shown on Figure 3.1-1.
- b. At least once per 31 days by verifying that each valve (manual, power operated or automatic) in the flow path that is not locked, sealed, or otherwise secured in position, is in its correct position.
- c. At least once per 18 months during shutdown by verifying that each automatic valve in the flow path actuates to its correct position on a SIAS test signal.
- d. At least once per 18 months by verifying that the flow path required by Specification 3.1.2.2.a delivers at least 40 gpm to the Reactor Coolant System.

## REACTIVITY CONTROL SYSTEMS

### CHARGING PUMPS - OPERATING

#### LIMITING CONDITION FOR OPERATION

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3.1.2.4 At least two charging pumps shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

With only one charging pump OPERABLE, restore at least two charging pumps to OPERABLE status within 72 hours or be in at least HOT STANDBY and borated to a SHUTDOWN MARGIN equivalent to at least 2% delta k/k at 200°F within the next 6 hours; restore at least two charging pumps to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.

#### SURVEILLANCE REQUIREMENTS

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4.1.2.4 No additional Surveillance Requirements other than those required by Specification 4.0.5.

## REACTIVITY CONTROL SYSTEMS

### BORIC ACID MAKEUP PUMPS - OPERATING

#### LIMITING CONDITION FOR OPERATION

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3.1.2.6 At least the boric acid makeup pump(s) in the boron injection flow path(s) required OPERABLE pursuant to Specification 3.1.2.2a shall be OPERABLE and capable of being powered from an OPERABLE emergency bus if the flow path through the boric acid pump(s) in Specification 3.1.2.2a is OPERABLE.

APPLICABILITY: MODES 1, 2, 3 and 4.

#### ACTION:

With one boric acid makeup pump required for the boron injection flow path(s) pursuant to Specification 3.1.2.2a inoperable, restore the boric acid makeup pump to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and borated to a SHUTDOWN MARGIN equivalent to at least 2% delta k/k at 200°F; restore the above required boric acid makeup pump(s) to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.

#### SURVEILLANCE REQUIREMENTS

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4.1.2.6 No additional Surveillance Requirements other than those required by Specification 4.0.5.

## REACTIVITY CONTROL SYSTEMS

### BORATED WATER SOURCES - OPERATING

#### LIMITING CONDITION FOR OPERATION

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- 3.1.2.8 Each of the following borated water sources shall be OPERABLE:
- a. At least one boric acid makeup tank and at least one associated heat tracing circuit with the contents of the tanks in accordance with Figure 3.1-1, and
  - b. The refueling water storage tank with:
    1. A minimum contained borated water volume of 362,800 gallons above the ECCS suction connection,
    2. Between 1720 and 2300 ppm of boron, and
    3. A solution temperature between 40°F and 100°F.

APPLICABILITY: MODES 1, 2, 3 and 4.

#### ACTION:

- a. With the above required boric acid makeup tank inoperable, restore the tank to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and borated to a SHUTDOWN MARGIN equivalent to at least 2% delta k/k at 200°F; restore the above required boric acid makeup tank to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.
- b. With the refueling water tank inoperable, restore the tank to OPERABLE status within 1 hour or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

#### SURVEILLANCE REQUIREMENTS

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- 4.1.2.8 Each borated water source shall be demonstrated OPERABLE:
- a. At least once per 7 days by:
    1. Verifying the boron concentration in the water,
    2. Verifying the contained borated water volume of the water source, and
    3. Verifying the boric acid makeup tank solution temperature.
  - b. At least once per 24 hours by verifying the RWST temperature when the outside air temperature is less than 40°F or greater than 100°F.

## REACTIVITY CONTROL SYSTEMS

### BASES

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#### 3/4.1.1.4 MINIMUM TEMPERATURE FOR CRITICALITY

This specification ensures that the reactor will not be made critical with the Reactor Coolant System average temperature less than 520°F. This limitation is required to ensure (1) the moderator temperature coefficient is within its analyzed temperature range, (2) the protective instrumentation is within its normal operating range, (3) the pressurizer is capable of being in an OPERABLE status with a steam bubble, and (4) the reactor pressure vessel is above its minimum  $RT_{NDT}$  temperature.

#### 3/4.1.2 BORATION SYSTEMS

The boron injection system ensures that negative reactivity control is available during each mode of facility operation. The components required to perform this function include (1) borated water sources, (2) charging pumps, (3) separate flow paths, (4) boric acid makeup pumps, (5) associated heat tracing systems, and (6) an emergency power supply from OPERABLE diesel generators.

With the RCS average temperature above 200°F, a minimum of two separate and redundant boron injection systems are provided to ensure single functional capability in the event an assumed failure renders one of the systems inoperable. Allowable out-of-service periods ensure that minor component repair or corrective action may be completed without undue risk to overall facility safety from injection system failures during the repair period.

The boration capability of either system is sufficient to provide a SHUTDOWN MARGIN from expected operating conditions of 2.0% delta k/k after xenon decay and cooldown to 200°F. The maximum expected boration capability requirement occurs at EOL from full power equilibrium xenon conditions and requires boric acid solution from the boric acid makeup tanks in the allowable concentrations and volumes of Specification 3.1.2.8 or 53,500 gallons of 1720 ppm borated water from the refueling water tank. However, for the purpose of consistency the minimum required volume of 362,800 gallons above ECCS suction connection in Specification 3.1.2.8 is identical to the more restrictive value of Specification 3.5.4.

With the RCS temperature below 200°F one injection system is acceptable without single failure consideration on the basis of the stable reactivity condition of the reactor and the additional restrictions prohibiting CORE ALTERATIONS and positive reactivity changes in the event the single injection system becomes inoperable.

The boron capability required below 200°F is based upon providing a 2% delta k/k SHUTDOWN MARGIN after xenon decay and cooldown from 200°F to 140°F. This condition requires either 5465 gallons of 1720 ppm borated water from the refueling water tank or boric acid solution from the boric acid makeup tanks in accordance with the requirements of Specification 3.1.2.7.

ATTACHMENT C

## REACTIVITY CONTROL SYSTEMS

SHUTDOWN MARGIN -  $T_{avg}$  LESS THAN OR EQUAL TO 200°F

### LIMITING CONDITION FOR OPERATION

3.1.1.2 The SHUTDOWN MARGIN shall be greater than or equal to 3.0% delta k/k.

APPLICABILITY: MODE 5.

#### ACTION:

With the SHUTDOWN MARGIN less than 3.0% delta k/k, immediately initiate and continue boration at greater than or equal to 40 gpm of a solution containing greater than or equal to 1720 ppm boron or equivalent until the required SHUTDOWN MARGIN is restored.

### SURVEILLANCE REQUIREMENTS

4.1.1.2 The SHUTDOWN MARGIN shall be determined to be greater than or equal to 3.0% delta k/k:

- a. Within one hour after detection of an inoperable CEA(s) and at least once per 12 hours thereafter while the CEA(s) is inoperable. If the inoperable CEA is immovable or untrippable, the above required SHUTDOWN MARGIN shall be increased by an amount at least equal to the withdrawn worth of the immovable or untrippable CEA(s).
- b. At least once per 24 hours by consideration of the following factors:
  1. Reactor coolant system boron concentration,
  2. CEA position,
  3. Reactor coolant system average temperature,
  4. Fuel burnup based on gross thermal energy generation,
  5. Xenon concentration, and
  6. Samarium concentration.
  7. Whenever the reactor coolant level is below the hot leg centerline, one and only one charging pump shall be operable; by verifying that power is removed from the remaining charging pumps.

## REACTIVITY CONTROL SYSTEMS

### BASES

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#### 3/4.1.1.4 MINIMUM TEMPERATURE FOR CRITICALITY

This specification ensures that the reactor will not be made critical with the Reactor Coolant System average temperature less than 520°F. This limitation is required to ensure 1) the moderator temperature coefficient is within its analyzed temperature range, 2) the protective instrumentation is within its normal operating range, 3) the pressurizer is capable of being in an OPERABLE status with a steam bubble, and 4) the reactor pressure vessel is above its minimum  $RT_{NDT}$  temperature.

#### 3/4.1.2 BORATION SYSTEMS

The boron injection system ensures that negative reactivity control is available during each mode of facility operation. The components required to perform this function include 1) borated water sources, 2) charging pumps, 3) separate flow paths, 4) boric acid makeup pumps, 5) associated heat tracing systems, and 6) an emergency power supply from OPERABLE diesel generators.

With the RCS average temperature above 200°F, a minimum of two separate and redundant boron injection systems are provided to ensure single functional capability in the event an assumed failure renders one of the systems inoperable. Allowable out-of-service periods ensure that minor component repair or corrective action may be completed without undue risk to overall facility safety from injection system failures during the repair period.

The boration capability of either system is sufficient to provide a SHUTDOWN MARGIN from expected operating conditions of 3.0% delta k/k after xenon decay and cooldown to 200°F. The maximum expected boration capability requirement occurs at EOL from full power equilibrium xenon conditions and requires boric acid solution from the boric acid makeup tanks in the allowable concentrations and volumes of Specification 3.1.2.8 or 53,500 gallons of 1720 ppm borated water from the refueling water tank. However, for the purpose of consistency the minimum required volume of 362,800 gallons above ECCS suction connection in Specification 3.1.2.8 is identical to the more restrictive value of Specification 3.5.4.

With the RCS temperature below 200°F one injection system is acceptable without single failure consideration on the basis of the stable reactivity condition of the reactor and the additional restrictions prohibiting CORE ALTERATIONS and positive reactivity changes in the event the single injection system becomes inoperable.

The boron capability required below 200°F is based upon providing a 3.0% delta k/k SHUTDOWN MARGIN after xenon decay and cooldown from 200°F to 140°F. This condition requires either 5465 gallons of 1720 ppm borated water from the refueling water tank or boric acid solution from the boric acid makeup tanks in accordance with the requirements of Specification 3.1.2.7.

## REACTIVITY CONTROL SYSTEMS

### FLOW PATHS - OPERATING

#### LIMITING CONDITION FOR OPERATION

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3.1.2.2 At least two of the following boron injection flow paths and one associated heat tracing circuit shall be OPERABLE:

- a. Flow paths from one or both boric acid makeup tanks via
  1. The associated gravity feed connection(s) and/or
  2. The associated boric acid makeup pump(s)via charging pump(s) to the RCS
- and/or
- b. The flow path from the refueling water storage tank via charging pump(s) to the Reactor Coolant System.

APPLICABILITY: MODES 1, 2, 3 and 4.

#### ACTION:

With only one of the above required boron injection flow paths to the Reactor Coolant System OPERABLE, restore at least two boron injection flow paths to the Reactor Coolant System to OPERABLE status within 72 hours or be in at least HOT STANDBY and borated to a SHUTDOWN MARGIN equivalent to at least  $3.0\% \Delta k/k$  at 200°F within the next 6 hours; restore at least two flow paths to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.

#### SURVEILLANCE REQUIREMENTS

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4.1.2.2 At least two of the above required flow paths shall be demonstrated OPERABLE:

- a. At least once per 7 days by verifying that the temperature of the heat traced portion of the flow path from the boric acid makeup tanks is above the temperature limit line shown on Figure 3.1-1.
- b. At least once per 31 days by verifying that each valve (manual, power operated or automatic) in the flow path that is not locked, sealed, or otherwise secured in position, is in its correct position.
- c. At least once per 18 months during shutdown by verifying that each automatic valve in the flow path actuates to its correct position on a SIAS test signal.
- d. At least once per 18 months by verifying that the flow path required by Specification 3.1.2.2.a delivers at least 40 gpm to the Reactor Coolant System.

## REACTIVITY CONTROL SYSTEMS

### CHARGING PUMPS - OPERATING

#### LIMITING CONDITION FOR OPERATION

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3.1.2.4 At least two charging pumps shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

With only one charging pump OPERABLE, restore at least two charging pumps to OPERABLE status within 72 hours or be in at least HOT STANDBY and borated to a SHUTDOWN MARGIN equivalent to at least  $3.0\% \Delta k/k$  at 200°F within the next 6 hours; restore at least two charging pumps to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.

#### SURVEILLANCE REQUIREMENTS

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4.1.2.4 No additional Surveillance Requirements other than those required by Specification 4.0.5.

## REACTIVITY CONTROL SYSTEMS

### BORIC ACID MAKEUP PUMPS - OPERATING

#### LIMITING CONDITION FOR OPERATION

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3.1.2.6 At least the boric acid makeup pump(s) in the boron injection flow path(s) required OPERABLE pursuant to Specification 3.1.2.2a shall be OPERABLE and capable of being powered from an OPERABLE emergency bus if the flow path through the boric acid pump(s) in Specification 3.1.2.2a is OPERABLE.

APPLICABILITY: MODES 1, 2, 3 and 4.

#### ACTION:

With one boric acid makeup pump required for the boron injection flow path(s) pursuant to Specification 3.1.2.2a inoperable, restore the boric acid makeup pump to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and borated to a SHUTDOWN MARGIN equivalent to at least 3.0% $\Delta$  k/k at 200°F; restore the above required boric acid makeup pump(s) to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.

#### SURVEILLANCE REQUIREMENTS

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4.1.2.6 No additional Surveillance Requirements other than those required by Specification 4.0.5.

## REACTIVITY CONTROL SYSTEMS

### BORATED WATER SOURCES - OPERATING

#### LIMITING CONDITION FOR OPERATION

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3.1.2.8 Each of the following borated water sources shall be OPERABLE:

- a. At least one boric acid makeup tank and at least one associated heat tracing circuit with the contents of the tanks in accordance with Figure 3.1-1, and
- b. The refueling water storage tank with:
  1. A minimum contained borated water volume of 362,800 gallons above the ECCS suction connection,
  2. Between 1720 and 2300 ppm of boron, and
  3. A solution temperature between 40°F and 100°F.

APPLICABILITY: MODES 1, 2, 3 and 4.

#### ACTION:

- a. With the above required boric acid makeup tank inoperable, restore the tank to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and borated to a SHUTDOWN MARGIN equivalent to at least  $3.0\% \Delta k/k$  at 200°F; restore the above required boric acid makeup tank to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.
- b. With the refueling water tank inoperable, restore the tank to OPERABLE status within one hour or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

#### SURVEILLANCE REQUIREMENTS

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4.1.2.8 Each borated water sources shall be demonstrated OPERABLE:

- a. At least once per 7 days by:
  1. Verifying the boron concentration in the water,
  2. Verifying the contained borated water volume of the water source, and
  3. Verifying the boric acid makeup tank solution temperature.
- b. At least once per 24 hours by verifying the RWST temperature when the outside air temperature is less than 40°F or greater than 100°F.

### 3/4.1 REACTIVITY CONTROL SYSTEMS

#### BASES

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#### 3/4.1.1 BORATION CONTROL

##### 3/4.1.1.1 and 3/4.1.1.2 SHUTDOWN MARGIN

A sufficient SHUTDOWN MARGIN ensures that 1) the reactor can be made subcritical from all operating conditions, 2) the reactivity transients associated with postulated accident conditions are controllable within acceptable limits, and 3) the reactor will be maintained sufficiently subcritical to preclude inadvertent criticality in the shutdown condition.

SHUTDOWN MARGIN requirements vary throughout core life as a function of fuel depletion, RCS boron concentration, and RCS  $T_{avg}$ . The most restrictive condition occurs at EOL, with  $T_{avg}$  at no load operating temperature, and is associated with a postulated steam line break accident and resulting uncontrolled RCS cooldown. In the analysis of this accident, a minimum SHUTDOWN MARGIN of 5.15%  $\Delta k/k$  is required to control the reactivity transient. Accordingly, the SHUTDOWN MARGIN requirement is based upon this limiting condition and is consistent with FSAR safety analysis assumptions. With  $T_{avg}$  less than or equal to 200°F, the reactivity transients resulting from any postulated accident are minimal and a 3.0%  $\Delta k/k$  shutdown margin provides adequate protection.

##### 3/4.1.1.3 MODERATOR TEMPERATURE COEFFICIENT

The limitations on moderator temperature coefficient (MTC) are provided to ensure that the assumptions used in the accident and transient analysis remain valid through each fuel cycle. The surveillance requirements for measurement of the MTC during each fuel cycle are adequate to confirm the MTC value since this coefficient changes slowly due principally to the reduction in RCS boron concentration associated with fuel burnup. The confirmation that the measured MTC value is within its limit provides assurances that the coefficient will be maintained within acceptable values throughout each fuel cycle.