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September 2, 1988

Posted
Amdt 154 to DPR-33

Dockets Nos. 50-259/260/296

Mr. S. A. White
Senior Vice President, Nuclear Power
Tennessee Valley Authority
6N 38A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

Dear Mr. White:

SUBJECT: STANDBY LIQUID CONTROL SYSTEM (SLCS) TECHNICAL SPECIFICATION CHANGES (TAC 00095, 00096, 00097) (TS 239)

The Commission has issued the enclosed Amendments Nos. 154,150 , and 125to Facility Operating Licenses Nos. DPR-33, DPR-52 and DPR-68 for the Browns Ferry Nuclear Plant, Units 1, 2 and 3, respectively. These amendments are in response to your application dated April 30, 1988. The amendments modify Technical Specification Section 3.4, Standby Liquid Control System, to allow the use of enriched sodium pentaborate.

A copy of the Safety Evaluation is also enclosed. Notice of Issuance will be included in the Commission's Bi-Weekly Federal Register Notice.

Sincerely,

Original Signed by

Suzanne Black, Assistant Director
for Projects
TVA Projects Division
Office of Special Projects

Enclosures:
1. Amendment No. 154 to License No. DPR-33
2. Amendment No. 150to License No. DPR-52
3. Amendment No. 125to License No. DPR-68
4. Safety Evaluation

cc w/enclosures:
See next page

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-259

BROWNS FERRY NUCLEAR PLANT, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 154
License No. DPR-33

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated April 20, 1988, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Facility Operating License No. DPR-33 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 154 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Suzanne Black

Suzanne Black, Assistant Director
for Projects
TVA Projects Division
Office of Special Projects

Attachment:
Changes to the Technical
Specifications

Date of Issuance: September 2, 1988

ATTACHMENT TO LICENSE AMENDMENT NO. 154

FACILITY OPERATING LICENSE NO. DPR-33

DOCKET NO. 50-259

Revise the Appendix A Technical Specifications by removing the pages identified below and inserting the enclosed pages. The revised pages are identified by the captioned amendment number and contain marginal lines indicating the area of change.

REMOVE	INSERT
3.4/4.4-1	3.4/4.4-1
3.4/4.4-2	3.4/4.4-2
3.4/4.4-3	3.4/4.4-3
3.4/4.4-4	3.4/4.4-4
3.4/4.4-5	3.4/4.4-5
3.4/4.4-6	3.4/4.4-6
3.4/4.4-7	-

LIMITING CONDITIONS FOR OPERATION	SURVEILLANCE REQUIREMENTS

3.4 STANDBY LIQUID CONTROL SYSTEM

Applicability

Applies to the operating status of the Standby Liquid Control System.

Objective

To assure the availability of a system with the capability to shut down the reactor and maintain the shutdown condition without the use of control rods.

Specification

A. Normal System Availability

1. Except as specified in 3.4.B.1, the Standby Liquid Control System shall be OPERABLE at all times when there is fuel in the reactor vessel and the reactor is not in a shutdown condition with Specification 3.3.A.1 satisfied.

4.4 STANDBY LIQUID CONTROL SYSTEM

Applicability

Applies to the surveillance requirements of the Standby Liquid Control System.

Objective

To verify the operability of the Standby Liquid Control System.

Specification

A. Normal System Availability

The operability of the Standby Liquid Control System shall be verified by the performance of the following tests:

1. At least once per month each pump loop shall be functionally tested.

2. At least once during each operating cycle:

   a. Check that the setting of the system relief valves is 1,425 ± 75 psig.

   b. Manually initiate the system, except explosive valves. Visually verify flow by pumping boron solution through the recirculation path and back to the Standby Liquid Control Solution Tank. After pumping boron solution, the system shall be flushed with demineralized water. Verify minimum

LIMITING CONDITIONS FOR OPERATION

SURVEILLANCE REQUIREMENTS

4.4.A Normal System Availability (Cont'd)

4.4.A.2.b. (Cont'd)

pump flow rate of 39 gpm against a system head of 1275 psig by pumping demineralized water from the Standby Liquid Control Test Tank.

c. Manually initiate one of the Standby Liquid Control System loops and pump demineralized water into the reactor vessel.

This test checks explosion of the charge associated with the tested loop, proper operation of the valves, and pump operability. Replacement charges shal be selected such that the age of charge in service shall not exceed five years from the manufacturer's assembly date.

d. Both systems, including both explosive valves, shall be tested in the course of two operating cycles.

3.4/4.4 STANDBY LIQUID CONTROL SYSTEM

LIMITING CONDITIONS FOR OPERATION	SURVEILLANCE REQUIREMENTS
3.4.B. Operation with Inoperable Components	4.4.B. Surveillance with Inoperable Components
1. From and after the date that a redundant component is made or found to be inoperable, Specification 3.4.A.1 shall be considered fulfilled and continued operation permitted provided that the component is returned to an operable condition within seven days.	1. When a component is found to be inoperable, its redundant component shall be demonstrated to be operable immediately and daily thereafter until the inoperable component is repaired.
3.4.C Sodium Pentaborate Solution	4.4.C Sodium Pentaborate Solution
At all times when the Standby Liquid Control System is required to be OPERABLE, the following conditions shall be met:	The following tests shall be performed to verify the availability of the Liquid Control Solution:
1. At least 180 pounds Boron-10 must be stored in the Standby Liquid Control Solution tank and be available for injection.	1. Volume: Check at least once per day.
2. The sodium pentaborate solution concentration must be equal to or less than 9.2% by weight.	2. Sodium Pentaborate Concentration check at least once per month. Also check concentration within 24 hours anytime water or boron is added to the solution.
	3. Boron-10 Quantity: At least once per month, calculate and record the quantity of Boron-10 stored in the Standby Liquid Control Solution Tank.
	4. Boron-10 Enrichment: At least once per 18 months and following each addition of boron to the Standby Liquid Control Solution Tank:

LIMITING CONDITIONS FOR OPERATION		SURVEILLANCE REQUIREMENTS	
			a. Calculate the enrichment within 24 hours. b. Verify by analysis within 30 days.
3.4.D	The Standby Liquid Control System conditions must satisfy the following equation. $\frac{(C)(Q)(E)}{(13\ wt.\%)(86\ gpm)(19.8\ atom\%)} \geq 1$ where, C = sodium pentaborate solution concentration (weight percent) Determined by the most recent performance of the surveillance instruction required by Specification 4.4.C.2. Q = pump flow rate (gpm) Determined by the most recent performance of the surveillance instruction required by Specification 4.4.A.2.b. E = Boron-10 enrichment (atom percent Boron-10) Determined by the most recent performance of the surveillance instruction required by Specification 4.4.C.4.	4.4.D	Verify that the equation given in Specification 3.4.D is satisfied at least once per month and within 24 hours anytime water or boron is added to the solution.
3.4.E	If Specification 3.4.A through 3.4.D cannot be met, make at least one subsystem operable within 8 hours or the reactor shall be placed in a Shutdown Condition with all operable control rods fully inserted within the following 12 hours.	4.4.E	No additional surveillance required.

3.4 BASES: STANDBY LIQUID CONTROL SYSTEM

A. If no more than one OPERABLE control rod is withdrawn, the basic shutdown reactivity requirement for the core is satisfied and the Standby Liquid Control System is not required. Thus, the basic reactivity requirement for the core is the primary determinant of when the liquid control system is required.

The purpose of the standby liquid control system is to provide the capability of bringing the reactor from full power to a cold, xenon-free shutdown condition assuming that none of the withdrawn control rods can be inserted. To meet this objective, the liquid control system is designed to inject a quantity of boron that produces a concentration greater than 660 ppm of natural boron in the reactor core. This amount of Boron-10 is required to bring the reactor from full power to a subcritical condition, considering the hot to cold reactivity difference, xenon poisoning, etc. The quantity of stored boron includes an additional margin (25 percent) beyond the amount needed to shut down the reactor to allow for possible imperfect mixing of the chemical solution in the reactor water.

The minimum limitation on the relief valve setting is intended to prevent the loss of liquid control solution via the lifting of a relief valve at too low a pressure. The upper limit on the relief valve settings provides system protection from overpressure.

B. Only one of the two standby liquid control pumping loops is needed for operating the system. One INOPERABLE pumping circuit does not immediately threaten shutdown capability, and reactor operation can continue while the circuit is being repaired. Assurance that the remaining system will perform its intended function and that the long-term average availability of the system is not reduced is obtained from a one-out-of-two system by an allowable equipment out-of-service time of one-third of the normal surveillance frequency. This method determines an equipment out-of-service time of 10 days. Additional conservatism is introduced by reducing the allowable out-of-service time to seven days, and by increased testing of the OPERABLE redundant component.

C. Level indication and alarm indicate whether the solution volume has changed, which might indicate a possible solution concentration change. The test interval has been established in consideration of these factors. Temperature and liquid level alarms for the system are annunciated in the control room.

The sodium pentaborate solution concentration is limited to less than 9.2 weight percent. This concentration limits the saturation temperature to 40° F which yields a 10° F margin below the minimum ambient temperature of 50° F.

D. To meet 10 CFR 50.62, the Standby Liquid Control System must have a minimum flow capacity and boron content equivalent in control capacity to 86 pgm of 13 weight percent natural sodium pentaborate solution.

3.4 BASES (Cont'd)

This equivalency requirement is met when the equation given in 3.4.D is satisfied. Each parameter in the equation is tested consistent with its potential to vary. The enriched sodium pentaborate solution is made by combining stoichiometric quantities of borox and boric acid in demineralized water. Since the chemicals used have known Boron-10 enrichments, the Boron-10 enrichment of the sodium pentaborate formed can be calculated. Following initial solution formation or chemical addition, the result of this calculation will be used to determine compliance with 3.4.D pending subsequent verification by analysis.

4.4 BASES: STANDBY LIQUID CONTROL SYSTEM

Experience with pump operability indicates that the monthly test, in combination with the tests during each operating cycle, is sufficient to maintain pump performance. Various components of the system are individually tested periodically, thus making unnecessary more frequent testing of the entire system.

The solution volume, concentration and B-10 enrichment are checked at a frequency to assure a high reliability of operation of the system should it ever be required.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-260

BROWNS FERRY NUCLEAR PLANT, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No.150
License No. DPR-52

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated April 20, 1988, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Facility Operating License No. DPR-52 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 150 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Suzanne Black

Suzanne Black, Assistant Director
for Projects
TVA Projects Division
Office of Special Projects

Attachment:
Changes to the Technical
Specifications

Date of Issuance: September 2, 1988

ATTACHMENT TO LICENSE AMENDMENT NO. 150

FACILITY OPERATING LICENSE NO. DPR-52

DOCKET NO. 50-260

Revise the Appendix A Technical Specifications by removing the pages identified below and inserting the enclosed pages. The revised pages are identified by the captioned amendment number and contain marginal lines indicating the area of change.

REMOVE	INSERT
3.4/4.4-1	3.4/4.4-1
3.4/4.4-2	3.4/4.4-2
3.4/4.4-3	3.4/4.4-3
3.4/4.4-4	3.4/4.4-4
3.4/4.4-5	3.4/4.4-5
3.4/4.4-6	3.4/4.4-6
3.4/4.4-7	-

LIMITING CONDITIONS FOR OPERATION

3.4 STANDBY LIQUID CONTROL SYSTEM

Applicability

Applies to the operating status of the Standby Liquid Control System.

Objective

To assure the availability of a system with the capability to shut down the reactor and maintain the shutdown condition without the use of control rods.

Specification

A. Normal System Availability

1. Except as specified in 3.4.B.1, the Standby Liquid Control System shall be OPERABLE at all times when there is fuel in the reactor vessel and the reactor is not in a shutdown condition with Specification 3.3.A.1 satisfied.

SURVEILLANCE REQUIREMENTS

4.4 STANDBY LIQUID CONTROL SYSTEM

Applicability

Applies to the surveillance requirements of the Standby Liquid Control System.

Objective

To verify the operability of the Standby Liquid Control System.

Specification

A. Normal System Availability

The operability of the Standby Liquid Control System shall be verified by the performance of the following tests:

1. At least once per month each pump loop shall be functionally tested.

2. At least once during each operating cycle:

   a. Check that the setting of the system relief valves is 1,425 ± 75 psig.

   b. Manually initiate the system, except explosive valves. Visually verify flow by pumping boron solution through the recirculation path and back to the Standby Liquid Control Solution Tank. After pumping boron solution, the system shall be flushed with demineralized water. Verify minimum

LIMITING CONDITIONS FOR OPERATION

SURVEILLANCE REQUIREMENTS

4.4.A Normal System Availability (Cont'd)

4.4.A.2.b. (Cont'd)

pump flow rate of 39 gpm against a system head of 1275 psig by pumping demineralized water from the Standby Liquid Control Test Tank.

c. Manually initiate one of the Standby Liquid Control System loops and pump demineralized water into the reactor vessel.

This test checks explosion of the charge associated with the tested loop, proper operation of the valves, and pump operability. Replacement charges shall be selected such that the age of charge in service shall not exceed five years from the manufacturer's assembly date.

d. Both systems, including both explosive valves, shall be tested in the course of two operating cycles.

LIMITING CONDITIONS FOR OPERATION	SURVEILLANCE REQUIREMENTS
3.4.B. Operation with Inoperable Components	4.4.B. Surveillance with Inoperable Components
1. From and after the date that a redundant component is made or found to be inoperable, Specification 3.4.A.1 shall be considered fulfilled and continued operation permitted provided that the component is returned to an operable condition within seven days.	1. When a component is found to be inoperable, its redundant component shall be demonstrated to be operable immediately and daily thereafter until the inoperable component is repaired.
3.4.C Sodium Pentaborate Solution	4.4.C Sodium Pentaborate Solution
At all times when the Standby Liquid Control System is required to be OPERABLE, the following conditions shall be met:	The following tests shall be performed to verify the availability of the Liquid Control Solution:
1. At least 180 pounds Boron-10 must be stored in the Standby Liquid Control Solution tank and be available for injection.	1. Volume: Check at least once per day.
2. The sodium pentaborate solution concentration must be equal to or less than 9.2% by weight.	2. Sodium Pentaborate Concentration check at least once per month. Also check concentration within 24 hours anytime water or boron is added to the solution.
	3. Boron-10 Quantity: At least once per month, calculate and record the quantity of Boron-10 stored in the Standby Liquid Control Solution Tank.
	4. Boron-10 Enrichment: At least once per 18 months and following each addition of boron to the Standby Liquid Control Solution Tank:

LIMITING CONDITIONS FOR OPERATION		SURVEILLANCE REQUIREMENTS	
			a. Calculate the enrichment within 24 hours. b. Verify by analysis within 30 days.
3.4.D	The Standby Liquid Control System conditions must satisfy the following equation. $\frac{(C)(Q)(E)}{(13\ wt.\%)(86\ gpm)(19.8\ atom\%)} \geq 1$ where, C = sodium pentaborate solution concentration (weight percent) Determined by the most recent performance of the surveillance instruction required by Specification 4.4.C.2. Q = pump flow rate (gpm) Determined by the most recent performance of the surveillance instruction required by Specification 4.4.A.2.b. E = Boron-10 enrichment (atom percent Boron-10) Determined by the most recent performance of the surveillance instruction required by Specification 4.4.C.4.	4.4.D	Verify that the equation given in Specification 3.4.D is satisfied at least once per month and within 24 hours anytime water or boron is added to the solution.
3.4.E	If Specification 3.4.A through 3.4.D cannot be met, make at least one subsystem operable within 8 hours or the reactor shall be placed in a Shutdown Condition with all operable control rods fully inserted within the following 12 hours.	4.4.E	No additional surveillance required.

3.4 BASES: STANDBY LIQUID CONTROL SYSTEM

A. If no more than one OPERABLE control rod is withdrawn, the basic shutdown reactivity requirement for the core is satisfied and the Standby Liquid Control System is not required. Thus, the basic reactivity requirement for the core is the primary determinant of when the liquid control system is required.

The purpose of the standby liquid control system is to provide the capability of bringing the reactor from full power to a cold, xenon-free shutdown condition assuming that none of the withdrawn control rods can be inserted. To meet this objective, the liquid control system is designed to inject a quantity of boron that produces a concentration greater than 660 ppm of natural boron in the reactor core. This amount of Boron-10 is required to bring the reactor from full power to a subcritical condition, considering the hot to cold reactivity difference, xenon poisoning, etc. The quantity of stored boron includes an additional margin (25 percent) beyond the amount needed to shut down the reactor to allow for possible imperfect mixing of the chemical solution in the reactor water.

The minimum limitation on the relief valve setting is intended to prevent the loss of liquid control solution via the lifting of a relief valve at too low a pressure. The upper limit on the relief valve settings provides system protection from overpressure.

B. Only one of the two standby liquid control pumping loops is needed for operating the system. One INOPERABLE pumping circuit does not immediately threaten shutdown capability, and reactor operation can continue while the circuit is being repaired. Assurance that the remaining system will perform its intended function and that the long-term average availability of the system is not reduced is obtained from a one-out-of-two system by an allowable equipment out-of-service time of one-third of the normal surveillance frequency. This method determines an equipment out-of-service time of 10 days. Additional conservatism is introduced by reducing the allowable out-of-service time to seven days, and by increased testing of the OPERABLE redundant component.

C. Level indication and alarm indicate whether the solution volume has changed, which might indicate a possible solution concentration change. The test interval has been established in consideration of these factors. Temperature and liquid level alarms for the system are annunciated in the control room.

The sodium pentaborate solution concentration is limited to less than 9.2 weight percent. This concentration limits the saturation temperature to 40° F which yields a 10° F margin below the minimum ambient temperature of 50° F.

D. To meet 10 CFR 50.62, the Standby Liquid Control System must have a minimum flow capacity and boron content equivalent in control capacity to 86 pgm of 13 weight percent natural sodium pentaborate solution.

3.4 BASES (Cont'd)

This equivalency requirement is met when the equation given in 3.4.D is satisfied. Each parameter in the equation is tested consistent with its potential to vary. The enriched sodium pentaborate solution is made by combining stoichiometric quantities of borox and boric acid in demineralized water. Since the chemicals used have known Boron-10 enrichments, the Boron-10 enrichment of the sodium pentaborate formed can be calculated. Following initial solution formation or chemical addition, the result of this calculation will be used to determine compliance with 3.4.D pending subsequent verification by analysis.

4.4 BASES: STANDBY LIQUID CONTROL SYSTEM

Experience with pump operability indicates that the monthly test, in combination with the tests during each operating cycle, is sufficient to maintain pump performance. Various components of the system are individually tested periodically, thus making unnecessary more frequent testing of the entire system.

The solution volume, concentration and B-10 enrichment are checked at a frequency to assure a high reliability of operation of the system should it ever be required.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-296

BROWNS FERRY NUCLEAR PLANT, UNIT 3

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 125
License No. DPR-68

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated April 20, 1988, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Facility Operating License No. DPR-68 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 125 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Suzanne Black

Suzanne Black, Assistant Director
for Projects
TVA Projects Division
Office of Special Projects

Attachment:
Changes to the Technical
Specifications

Date of Issuance: September 2, 1988

ATTACHMENT TO LICENSE AMENDMENT NO. 125

FACILITY OPERATING LICENSE NO. DPR-68

DOCKET NO. 50-296

Revise the Appendix A Technical Specifications by removing the pages identified below and inserting the enclosed pages. The revised pages are identified by the captioned amendment number and contain marginal lines indicating the area of change.

REMOVE	INSERT
3.4/4.4-1	3.4/4.4-1
3.4/4.4-2	3.4/4.4-2
3.4/4.4-3	3.4/4.4-3
3.4/4.4-3	3.4/4.4-3
3.4/4.4-4	3.4/4.4-4
3.4/4.4-5	3.4/4.4-5
3.4/4.4-6	3.4/4.4-6
3.4/4.4-7	-

LIMITING CONDITIONS FOR OPERATION	SURVEILLANCE REQUIREMENTS
3.4 STANDBY LIQUID CONTROL SYSTEM	4.4 STANDBY LIQUID CONTROL SYSTEM
Applicability	Applicability
Applies to the operating status of the Standby Liquid Control System.	Applies to the surveillance requirements of the Standby Liquid Control System.
Objective	Objective
To assure the availability of a system with the capability to shut down the reactor and maintain the shutdown condition without the use of control rods.	To verify the operability of the Standby Liquid Control System.
Specification	Specification
A. Normal System Availability	A. Normal System Availability
1. Except as specified in 3.4.B.1, the Standby Liquid Control System shall be OPERABLE at all times when there is fuel in the reactor vessel and the reactor is not in a shutdown condition with Specification 3.3.A.1 satisfied.	The operability of the Standby Liquid Control System shall be verified by the performance of the following tests: 1. At least once per month each pump loop shall be functionally tested. 2. At least once during each operating cycle: a. Check that the setting of the system relief valves is 1,425 ± 75 psig. b. Manually initiate the system, except explosive valves. Visually verify flow by pumping boron solution through the recirculation path and back to the Standby Liquid Control Solution Tank. After pumping boron solution, the system shall be flushed with demineralized water. Verify minimum

LIMITING CONDITIONS FOR OPERATION	SURVEILLANCE REQUIREMENTS
	4.4.A Normal System Availability (Cont'd)
	4.4.A.2.b. (Cont'd)
	pump flow rate of 39 gpm against a system head of 1275 psig by pumping demineralized water from the Standby Liquid Control Test Tank.
	c. Manually initiate one of the Standby Liquid Control System loops and pump demineralized water into the reactor vessel.
	This test checks explosion of the charge associated with the tested loop, proper operation of the valves, and pump operability. Replacement charges sha. be selected such that the age of charge in service shall not exceed five years from the manufacturer's assembly date.
	d. Both systems, including both explosive valves, shall be tested in the course of two operating cycles.

LIMITING CONDITIONS FOR OPERATION	SURVEILLANCE REQUIREMENTS
3.4.B. Operation with Inoperable Components 1. From and after the date that a redundant component is made or found to be inoperable, Specification 3.4.A.1 shall be considered fulfilled and continued operation permitted provided that the component is returned to an operable condition within seven days.	4.4.B. Surveillance with Inoperable Components 1. When a component is found to be inoperable, its redundant component shall be demonstrated to be operable immediately and daily thereafter until the inoperable component is repaired.
3.4.C Sodium Pentaborate Solution At all times when the Standby Liquid Control System is required to be OPERABLE, the following conditions shall be met: 1. At least 180 pounds Boron-10 must be stored in the Standby Liquid Control Solution tank and be available for injection. 2. The sodium pentaborate solution concentration must be equal to or less than 9.2% by weight.	4.4.C Sodium Pentaborate Solution The following tests shall be performed to verify the availability of the Liquid Control Solution: 1. Volume: Check at least once per day. 2. Sodium Pentaborate Concentration check at least once per month. Also check concentration within 24 hours anytime water or boron is added to the solution. 3. Boron-10 Quantity: At least once per month, calculate and record the quantity of Boron-10 stored in the Standby Liquid Control Solution Tank. 4. Boron-10 Enrichment: At least once per 18 months and following each addition of boron to the Standby Liquid Control Solution Tank:

LIMITING CONDITIONS FOR OPERATION		SURVEILLANCE REQUIREMENTS	
			a. Calculate the enrichment within 24 hours. b. Verify by analysis within 30 days.
3.4.D	The Standby Liquid Control System conditions must satisfy the following equation. $\frac{(C)(Q)(E)}{(13\ wt.\%)(86\ gpm)(19.8\ atom\%)} \geq 1$ where, C = sodium pentaborate solution concentration (weight percent) Determined by the most recent performance of the surveillance instruction required by Specification 4.4.C.2. Q = pump flow rate (gpm) Determined by the most recent performance of the surveillance instruction required by Specification 4.4.A.2.b. E = Boron-10 enrichment (atom percent Boron-10) Determined by the most recent performance of the surveillance instruction required by Specification 4.4.C.4.	4.4.D	Verify that the equation given in Specification 3.4.D is satisfied at least once per month and within 24 hours anytime water or boron is added to the solution.
3.4.E	If Specification 3.4.A through 3.4.D cannot be met, make at least one subsystem operable within 8 hours or the reactor shall be placed in a Shutdown Condition with all operable control rods fully inserted within the following 12 hours.	4.4.E	No additional surveillance required.

3.4 BASES: STANDBY LIQUID CONTROL SYSTEM

A. If no more than one OPERABLE control rod is withdrawn, the basic shutdown reactivity requirement for the core is satisfied and the Standby Liquid Control System is not required. Thus, the basic reactivity requirement for the core is the primary determinant of when the liquid control system is required.

The purpose of the standby liquid control system is to provide the capability of bringing the reactor from full power to a cold, xenon-free shutdown condition assuming that none of the withdrawn control rods can be inserted. To meet this objective, the liquid control system is designed to inject a quantity of boron that produces a concentration greater than 660 ppm of natural boron in the reactor core. This amount of Boron-10 is required to bring the reactor from full power to a subcritical condition, considering the hot to cold reactivity difference, xenon poisoning, etc. The quantity of stored boron includes an additional margin (25 percent) beyond the amount needed to shut down the reactor to allow for possible imperfect mixing of the chemical solution in the reactor water.

The minimum limitation on the relief valve setting is intended to prevent the loss of liquid control solution via the lifting of a relief valve at too low a pressure. The upper limit on the relief valve settings provides system protection from overpressure.

B. Only one of the two standby liquid control pumping loops is needed for operating the system. One INOPERABLE pumping circuit does not immediately threaten shutdown capability, and reactor operation can continue while the circuit is being repaired. Assurance that the remaining system will perform its intended function and that the long-term average availability of the system is not reduced is obtained from a one-out-of-two system by an allowable equipment out-of-service time of one-third of the normal surveillance frequency. This method determines an equipment out-of-service time of 10 days. Additional conservatism is introduced by reducing the allowable out-of-service time to seven days, and by increased testing of the OPERABLE redundant component.

C. Level indication and alarm indicate whether the solution volume has changed, which might indicate a possible solution concentration change. The test interval has been established in consideration of these factors. Temperature and liquid level alarms for the system are annunciated in the control room.

The sodium pentaborate solution concentration is limited to less than 9.2 weight percent. This concentration limits the saturation temperature to 40° F which yields a 10° F margin below the minimum ambient temperature of 50° F.

D. To meet 10 CFR 50.62, the Standby Liquid Control System must have a minimum flow capacity and boron content equivalent in control capacity to 86 pgm of 13 weight percent natural sodium pentaborate solution.

3.4 BASES (Cont'd)

This equivalency requirement is met when the equation given in 3.4.D is satisfied. Each parameter in the equation is tested consistent with its potential to vary. The enriched sodium pentaborate solution is made by combining stoichiometric quantities of borox and boric acid in demineralized water. Since the chemicals used have known Boron-10 enrichments, the Boron-10 enrichment of the sodium pentaborate formed can be calculated. Following initial solution formation or chemical addition, the result of this calculation will be used to determine compliance with 3.4.D pending subsequent verification by analysis.

4.4 BASES: STANDBY LIQUID CONTROL SYSTEM

Experience with pump operability indicates that the monthly test, in combination with the tests during each operating cycle, is sufficient to maintain pump performance. Various components of the system are individually tested periodically, thus making unnecessary more frequent testing of the entire system.

The solution volume, concentration and B-10 enrichment are checked at a frequency to assure a high reliability of operation of the system should it ever be required.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF SPECIAL PROJECTS

SUPPORTING AMENDMENT NO. 154 TO FACILITY OPERATING LICENSE NO. DPR-33

AMENDMENT NO. 150 TO FACILITY OPERATING LICENSE NO. DPR-52

AMENDMENT NO. 125 TO FACILITY OPERATING LICENSE NO. DPR-68

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2 AND 3

DOCKET NO. 50-259, 50-260 AND 50-296

1.0 INTRODUCTION

By letter dated April 20, 1988, the Tennessee Valley Authority (TVA or the licensee) requested an amendment to Appendix A of the Brown's Ferry Nuclear Plant (BFN) Units 1, 2 and 3 Technical Specifications (TS). The proposed amendment would modify the Standby Liquid Control System (SLCS) TS to allow the use of enriched sodium pentaborate. This includes modifying the limiting conditions for operation of TS Section 3.4.C to restore the cold shutdown requirement in terms of Boron-10 and to limit the concentration of the sodium pentaborate solution, thus limiting the saturation temperature. TS 3.4.D is added to incorporate an equivalency equation to ensure that the requirements for reduction of risk from Anticipated Transients Without Scram (ATWS) events of 10 CFR 50.62 are met.

Three new surveillance requirements are added providing for: (1) the calculation and recording of the quantity of Boron-10 in the SLC solution tank at least once per month, (2) the verification of Boron-10 enrichment following the addition of any Boron to the solution, and (3) the verification that the equivalency equation given in 3.4.D is satisfied.

Due to the lower required concentration of sodium pentaborate and its associated saturation temperature the requirement to monitor the solution temperature is deleted. In addition, Figure 3.4-1, "Sodium Pentaborate Solution Volume - Concentration Requirements" and Figure 3.4-2 "Sodium Pentaborate Solution Temperature Requirements" are deleted.

The final TS change would revise TS 3.4.A.1, SLCS operability requirements. The proposed change would replace the requirement that all operable control rods be fully inserted with a requirement that the reactivity limitations of TS 3.3.A.1 be satisfied.

2.0 EVALUATION

Paragraph (c)(4) of 10 CFR 50.62 states in part, "Each boiling water reactor must have a Standby Liquid Control System (SLCS) with a minimum flow capacity and boron content equivalent in control capacity to 86 gallons per minute of 13 weight percent sodium pentaborate solution." Two options for meeting this requirement are (1) increased flow rate by two pump operation or (2) the use of enriched boron. The licensee in its letter dated April 20, 1988 informed the staff of their intent to meet the above requirement by utilizing Boron-10 enrichment.

2.1 Equivalency with the ATWS Rule

The requirement of the ATWS rule in 10 CFR 50.62, paragraph (c)(4) is that the SLCS have a minimum flow capacity and boron content equivalent in control capacity to 86 gallons per minute of 13 weight percent sodium pentaborate solution. This requirement assumes the use of natural boron which contains 19.8 atom percent Boron-10. Boron-10 is the isotope of concern when determining the control capacity of the sodium pentaborate. Equivalency can be satisfied by comparing concentration, flow rate, and Boron-10 enrichment for the actual system with the ATWS rule. BFN will continue to check the solution concentration at least once a month and any time water or boron is added to the solution. The flow rate used in the equation will be determined once during each operating cycle as required by TS Section 4.4.A.2.b. A requirement is added to calculate and subsequently verify by analysis the Boron-10 enrichment following each addition of boron to the solution tank.

2.2 Standby Liquid Control System Requirements for Cold Shutdown

Currently, the Browns Ferry Nuclear Plant Final Safety Analysis Report (FSAR) specifies 600 ppm natural boron as the average concentration in the reactor coolant to provide the required shutdown margin. This concentration will not be adequate to meet the SLCS shutdown margin requirements for future cycles beginning with cycle 6 of Unit 2. TVA Reactor Fuel and Analysis staff, along with General Electric, has confirmed that 660ppm natural boron will satisfy the SLCS shutdown requirement for projected future cycles. This 660 ppm natural boron concentration is increased by 25 percent to 825 ppm natural boron to allow for imperfect mixing, leakage, and piping connected to the reactor.

Using this 825 ppm natural boron and the volume of reactor coolant in cold shutdown condition, the amount of natural boron required can be determined. Then using 19.8 percent, the atom percent of Boron-10 in natural boron, the amount of Boron-10 required for cold shutdown can be determined. This calculation shows that 179.4 pounds of Boron-10 is required to achieve cold shutdown. Therefore, at least 180 pounds of Boron-10 must be stored in the SLCS solution tank at all times when the SLCS is required to be operable.

2.3 Maximum Allowed Sodium Pentaborate Concentration Without Heat Tracing

TVA Drawing 47W225-63 gives a minimum normal temperature of 60°F and a minimum abnormal temperature of 50°F for the SLC tank area on elevation 639.0 of the Reactor Building. The saturation temperature of a 9.2 weight percent sodium pentaborate solution is 40°F. Thus, a 10°F margin is maintained at all times.

The temperature monitoring requirements have been deleted from the technical specifications since the new upper limit on the solution concentration has been set at 9.2 weight percent sodium pentaborate. At this concentration, the saturation temperature is 10°F below the minimum abnormal temperature for that area of the building. Therefore, TS surveillance of the solution temperature is no longer necessary. However, a temperature alarm at a preset low temperature will remain in operation. Its alarm setpoint will be changed to 50°F plus an allowance for drift.

The current TS bases state that should evaporation occur the low level alarm will annunciate before the temperature-concentration requirements are exceeded. The revised bases have deleted this statement since (1) the volume and concentration requirements have changed, (2) the system heat tracing will no longer be used for normal operation, thereby reducing any evaporative losses, and (3) significant evaporation has not occurred in the past.

The low level alarm setpoint has been lowered because of the reduced volume of solution required. The high level alarm setpoint has also been lowered which will enhance its primary safety function of warning the operator before the tank can overflow if water is being added accidently.

2.4 Solution Surveillance

The tank level will be observed daily. The sodium pentaborate concentration will be analyzed with the same frequency as at present. In addition, the Boron-10 enrichment will be determined by calculation within 24 hours of an addition of boron and once per 18 months. The 24-hour interval is based on engineering judgment considering the capability to perform the surveillance. Calculations will be confirmed by analysis within 30 days. BFN intends to have the capability to perform the enrichment analysis on site within seven days of the addition of boron. A 30-day period has been proposed should a sample need to be sent off site because of test equipment inoperability. Since enrichment is not expected to vary over time except by addition of boron with a different Boron-10 enrichment, this is an adequate surveillance interval. The possibility of a loss of enrichment control will be precluded by procurement from a certified vendor, segregated storage, random sampling prior to use by an offsite laboratory, the removal from the site of all remaining natural boron, and the handling and addition of boron only by chemistry personnel.

2.5 Normal System Availability

The bases for specification 3.4.A.1 states "If no more than one operable control rod is withdrawn, the basic shutdown reactivity for the core is satisfied and the SLCS is not required." This comes from TS 3.3.A.1, which requires a sufficient number of control rods operable to make the core subcritical in the most reactive condition with the strongest control rod fully withdrawn and all other operable rods fully inserted. Meeting TS 3.3.A.1 will assure a sufficient reactivity margin is available to shutdown the reactor with control rods. Revising TS 3.4.A.1 to require the SLCS to be operable when there is fuel in the reactor vessel and the reactor is not shutdown, with TS 3.3.A.1 satisfied, will provide consistency among the TS. This change is also similar to Standard TS (NUREG 1202) which allows the control rods to be withdrawn under limited conditions while not requiring the SLCS to be operable.

The surveillance requirements are being revised to eliminate ambiguity by reordering the sentences in TS 4.4.A.2.b. This change is included for clarification only and does not result from any change in the testing procedure.

2.6 Shutdown Requirement

Technical Specification 3.4.E is revised and renumbered to allow eight hours to make at least one of the subsystems operable or shut down the reactor within the following twelve hours. With the SLCS unable to perform its function, continued operation is only justifiable for a short time period. The eight hour timeframe is based on engineering judgment considering the low probability of the requirement to use the SLCS. If at least one subsystem cannot be made operable, the reactor must be placed in hot shutdown within the following twelve hours. The twelve hour timeframe to reach hot shutdown is based on engineering judgment considering the capability to reach the specified condition. Insertion of all control rods places the plant in a condition that does not require the SLCS to be operable. The eight and twelve hour timeframes are consistent with the Standard Technical Specifications (NUREG 1202) and are more conservative than the present 24 hours to achieve shutdown. In addition, an explicit eight hours are allowed from the discovery of the total inoperability to attempt to fix the problem before initiating actions to bring the plant to hot shutdown.

2.7 Conclusion

The proposed TS changes discussed above are warranted in order to comply with the ATWS requirements of 10 CFR 50.62, to meet the SLCS shutdown requirements for future fuel cycles, and to clarify the TS. The staff has therefore concluded that the proposed changes increase the margin of nuclear safety and are acceptable.

3.0 ENVIRONMENTAL CONSIDERATION

The amendments involve a change to a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and/or changes to the surveillance requirements. The staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that these amendments involve no significant hazards consideration and there has been no public comment on such finding. Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement nor environmental assessment need be prepared in connection with the issuance of these amendments.

4.0 CONCLUSION

The Commission made a proposed determination that the amendment involves no significant hazards consideration which was published in the Federal Register (53 FR 24516) on June 29, 1988 and consulted with the State of Alabama. No public comments were received and the State of Alabama did not have any comments.

The staff has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (2) such activities will be conducted in compliance with the Commission's regulations, and the issuance of the amendments will not be inimical to the common defense and security nor to the health and safety of the public.

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Dated: September 2, 1988