



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-259

BROWNS FERRY NUCLEAR PLANT, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 208
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 July 19, 1993, complies with the standards and requirements of the Atomic Energy of 1954, as amended 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.

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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. 208, 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 30 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Frederick J. Hebdon, Director
Project Directorate II-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: June 28, 1994

ATTACHMENT TO LICENSE AMENDMENT NO. 208

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

3.6/4.6-5
3.6/4.6-6
3.6/4.6-7
3.6/4.6-8
3.6/4.6-28
3.6/4.6-29

INSERT

3.6/4.6-5
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3.6/4.6 PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

SURVEILLANCE REQUIREMENTS

3.6.B. Coolant Chemistry

1. PRIOR TO STARTUP and at steaming rates less than 100,000 lb/hr, the following limits shall apply.
 - a. Conductivity, $\mu\text{mho/cm}$ at 25°C 2.0
 - b. Chloride, ppm 0.1

2. At steaming rates greater than 100,000 lb/hr, the following limits shall apply.
 - a. Conductivity, $\mu\text{mho/cm}$ at 25°C 1.0
 - b. Chloride, ppm 0.2

4.6.B. Coolant Chemistry

1. Reactor coolant shall be continuously monitored for conductivity except when there is no fuel in the reactor vessel.
 - a. Whenever the continuous conductivity monitor is inoperable, a sample of reactor coolant shall be analyzed for conductivity every 4 hours except as listed below. If the reactor is in COLD SHUTDOWN CONDITION, a sample of reactor coolant shall be analyzed for conductivity every 8 hours.
 - b. Once a week the continuous monitor shall be checked with an in-line flow cell. This in-line conductivity calibration shall be performed every 24 hours whenever the reactor coolant conductivity is $>1.0 \mu\text{mho/cm}$ at 25°C.

2. During startup prior to pressurizing the reactor above atmospheric pressure, measurements of reactor water quality shall be performed to show conformance with 3.6.B.1 of limiting conditions.

3.6/4.6 PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

SURVEILLANCE REQUIREMENTS

3.6.B. Coolant Chemistry

3. At steaming rates greater than 100,000 lb/hr, the reactor water quality may exceed Specification 3.6.B.2 only for the time limits specified below. Exceeding these time limits of the following maximum quality limits shall be cause for placing the reactor in the COLD SHUTDOWN CONDITION.
 - a. Conductivity time above
1 $\mu\text{mho/cm}$ at 25°C -
2 weeks/year.
Maximum Limit
10 $\mu\text{mho/cm}$ at 25°C
 - b. Chloride concentration time
above 0.2 ppm -
2 weeks/year.
Maximum Limit -
0.5 ppm.
 - c. The reactor shall be placed in the SHUTDOWN CONDITION if pH <5.6 or >8.6 for a 24-hour period.

4.6.B. Coolant Chemistry

3. Whenever the reactor is operating (including HOT STANDBY CONDITION) measurements of reactor water quality shall be performed according to the following schedule:
 - a. Chloride ion content and pH shall be measured at least once every 96 hours.
 - b. Chloride ion content shall be measured at least every 8 hours whenever reactor conductivity is >1.0 $\mu\text{mho/cm}$ at 25°C.
 - c. A sample of reactor coolant shall be measured for pH at least once every 8 hours whenever the reactor coolant conductivity is >1.0 $\mu\text{mho/cm}$ at 25°C.

3.6/4.6 PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

SURVEILLANCE REQUIREMENTS

3.6.B. Coolant Chemistry

4. When the reactor is not pressurized with fuel in the reactor vessel, except during the STARTUP CONDITION, the reactor water shall be maintained within the following limits.
 - a. Conductivity -
10 μ mho/cm at 25°C
 - b. Chloride - 0.5 ppm
 - c. pH shall be between
5.3 and 8.6.
5. When the time limits or maximum conductivity or chloride concentration limits are exceeded, an orderly shutdown shall be initiated immediately. The reactor shall be brought to the COLD SHUTDOWN CONDITION as rapidly as cooldown rate permits.
6. Whenever the reactor is critical, the limits on activity concentrations in the reactor coolant shall not exceed the equilibrium value of 3.2 μ Ci/gm of dose equivalent I-131.

4.6.B. Coolant Chemistry

4. Whenever the reactor is not pressurized with fuel in the reactor vessel, a sample of the reactor coolant shall be analyzed at least every 96 hours for conductivity, chloride ion content and pH.
5. During equilibrium power operation an isotopic analysis, including quantitative measurements for at least I-131, I-132, I-133, and I-134 shall be performed monthly on a coolant liquid sample.
6. Additional coolant samples shall be taken whenever the reactor activity exceeds one percent of the equilibrium concentration specified in 3.6.B.6 and one of the following conditions are met:

3.6/4.6 PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

3.6.B. Coolant Chemistry

3.6.B.6 (Cont'd)

This limit may be exceeded following power transients for a maximum of 48 hours. During this activity transient the iodine concentrations shall not exceed 26 $\mu\text{Ci/gm}$ whenever the reactor is critical. The reactor shall not be operated more than 5% of its yearly power operation under this exception for the equilibrium activity limits. If the iodine concentration in the coolant exceeds 26 $\mu\text{Ci/gm}$, the reactor shall be shut down, and the steam line isolation valves shall be closed immediately.

7. When there is no fuel in the reactor vessel, technical specification reactor coolant chemistry limits do not apply.

SURVEILLANCE REQUIREMENTS

4.6.B. Coolant Chemistry

4.6.B.6 (Cont'd)

- a. During the STARTUP CONDITION
- b. Following a significant power change**
- c. Following an increase in the equilibrium off-gas level exceeding 10,000 $\mu\text{Ci/sec}$ (at the steam jet air ejector) within a 48-hour period.
- d. Whenever the equilibrium iodine limit specified in 3.6.B.6 is exceeded.

The additional coolant liquid samples shall be taken at 4 hour intervals for 48 hours, or until a stable iodine concentration below the limiting value (3.2 $\mu\text{Ci/gm}$) is established. However, at least 3 consecutive samples shall be taken in all cases. An isotopic analysis shall be performed for each sample, and quantitative measurements made to determine the dose equivalent I-131 concentration.

7. When there is no fuel in the reactor vessel, sampling of reactor coolant chemistry at technical specification frequency is not required.

** For the purpose of this section on sampling frequency, a significant power exchange is defined as a change exceeding 15% of rated power in less than 1 hour.

3.6/4.6 BASES

3.6.A/4.6.A (Cont'd)

total of 100°F. The partial boltup is restricted to the full loading of eight studs at 70°F, which is stud NDT temperature (10°F) plus 60°F. The neutron radiation fluence at the closure flanges is well below 10^{17} nvt \geq 1 Mev; therefore, radiation effects will be minor and will not influence this temperature.

3.6.B/4.6.B Coolant Chemistry

Materials in the primary system are primarily 304 stainless steel and the Zircaloy cladding. The reactor water chemistry limits are established to prevent damage to these materials. Limits are placed on conductivity and chloride concentrations. Conductivity is limited because it is continuously measured and gives an indication of abnormal conditions and the presence of unusual materials in the coolant. Chloride limits are specified to prevent stress corrosion cracking of stainless steel.

Zircaloy does not exhibit similar stress corrosion failures. However, there are some operating conditions under which the dissolved oxygen content of the reactor coolant water could be higher than .2-.3 ppm, such as reactor STARTUP and Hot Standby. During these periods, the most restrictive limits for conductivity and chlorides have been established. When steaming rates exceed 100,000 lb/hr, boiling deaerates the reactor water. This reduces dissolved oxygen concentration and assures minimal chloride-oxygen content, which together tend to induce stress corrosion cracking.

When conductivity is in its normal range, pH and chloride and other impurities affecting conductivity must also be within their normal range. When conductivity becomes abnormal, then chloride measurements are made to determine whether or not they are also out of their normal operating values. This would not necessarily be the case. Conductivity could be high due to the presence of a neutral salt which would not have an effect on pH or chloride. In such a case, high conductivity alone is not a cause for shutdown. In some types of water-cooled reactors, conductivities are in fact high due to purposeful addition of additives. In the case of BWRs, however, where no additives are used and where near neutral pH is maintained, conductivity provides a very good measure of the quality of the reactor water. Significant changes therein provide the operator with a warning mechanism so he can investigate and remedy the condition causing the change before limiting conditions, with respect to variables affecting the boundaries of the reactor coolant, are exceeded. Methods available to the operator for correcting the off-standard condition include operation of the reactor cleanup system, reducing the input of impurities and placing the reactor in the Cold Shutdown condition. The major benefit of Cold Shutdown is to reduce the temperature dependent corrosion rates and provide time for the cleanup system to reestablish the purity of the reactor coolant.

The conductivity of the reactor coolant is continuously monitored when there is fuel in the reactor vessel. Once a week the continuous monitor is checked with an in-line flow cell and is considered adequate to assure accurate readings of the monitors. If conductivity is within its

3.6/4.6 BASES

3.6.B/4.6.B (Cont'd)

normal range, chlorides and other impurities will also be within their normal ranges. The reactor coolant samples will also be used to determine the chlorides. Therefore, the sampling frequency is considered adequate to detect long-term changes in the chloride ion content.

The basis for the equilibrium coolant iodine activity limit is a computed dose to the thyroid of 36 rem at the exclusion distance during the two-hour period following a steam line break. This dose is computed with the conservative assumption of a release of 140,000 lbs of coolant prior to closure of the isolation valves, and a X/Q value of 3.4×10^{-4} Sec/m³.

The maximum activity limit during a short term transient is established from consideration of a maximum iodine inhalation dose less than 300 rem. The probability of a steam line break accident coincident with an iodine concentration transient is significantly lower than that of the accident alone, since operation of the reactor with iodine levels above the equilibrium value is limited to 5 percent of total operation.

The sampling frequencies are established in order to detect the occurrence of an iodine transient which may exceed the equilibrium concentration limit, and to assure that the maximum coolant iodine concentrations are not exceeded. Additional sampling is required following power changes and off-gas transients, since present data indicate that the iodine peaking phenomenon is related to these events.

3.6.C/4.6.C Coolant Leakage

Allowable leakage rates of coolant from the reactor coolant system have been based on the predicted and experimentally observed behavior of cracks in pipes and on the ability to makeup coolant system leakage in the event of loss of offsite ac power. The normally expected background leakage due to equipment design and the detection capability for determining coolant system leakage were also considered in establishing the limits. The behavior of cracks in piping systems has been experimentally and analytically investigated as part of the USAEC sponsored Reactor Primary Coolant System Rupture Study (the Pipe Rupture Study). Work utilizing the data obtained in this study indicates that leakage from a crack can be detected before the crack grows to a dangerous or critical size by mechanically or thermally induced cyclic loading, or stress corrosion cracking or some other mechanism characterized by gradual crack growth. This evidence suggests that for leakage somewhat greater than the limit specified for unidentified leakage, the probability is small that imperfections or cracks associated with such leakage would grow rapidly. However, the establishment of allowable unidentified leakage greater than that given in 3.6.C on the basis of the data presently available would be premature because of uncertainties associated with the data. For leakage of the order of five gpm, as specified in 3.6.C, the experimental and analytical data



UNITED STATES
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TENNESSEE VALLEY AUTHORITY
DOCKET NO. 50-260
BROWNS FERRY NUCLEAR PLANT, UNIT 2
AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 224
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 July 19, 1993, 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.



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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. 224, 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 30 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Frederick J. Hebdon, Director
Project Directorate II-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: June 28, 1994

ATTACHMENT TO LICENSE AMENDMENT NO. 224

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

3.6/4.6-5
3.6/4.6-6
3.6/4.6-7
3.6/4.6-8
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3.6/4.6-5
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3.6/4.6 PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

SURVEILLANCE REQUIREMENTS

3.6.B. Coolant Chemistry

1. PRIOR TO STARTUP and at steaming rates less than 100,000 lb/hr, the following limits shall apply.
 - a. Conductivity, $\mu\text{mho/cm}$ at 25°C 2.0
 - b. Chloride, ppm 0.1

2. At steaming rates greater than 100,000 lb/hr, the following limits shall apply.
 - a. Conductivity, $\mu\text{mho/cm}$ at 25°C 1.0
 - b. Chloride, ppm 0.2

4.6.B. Coolant Chemistry

1. Reactor coolant shall be continuously monitored for conductivity except when there is no fuel in the reactor vessel.
 - a. Whenever the continuous conductivity monitor is inoperable, a sample of reactor coolant shall be analyzed for conductivity every 4 hours except as listed below. If the reactor is in COLD SHUTDOWN CONDITION, a sample of reactor coolant shall be analyzed for conductivity every 8 hours.
 - b. Once a week the continuous monitor shall be checked with an in-line flow cell. This in-line conductivity calibration shall be performed every 24 hours whenever the reactor coolant conductivity is $>1.0 \mu\text{mho/cm}$ at 25°C.

2. During startup prior to pressurizing the reactor above atmospheric pressure, measurements of reactor water quality shall be performed to show conformance with 3.6.B.1 of limiting conditions.

3.6/4.6. PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

3.6.B. Coolant Chemistry

3. At steaming rates greater than 100,000 lb/hr, the reactor water quality may exceed Specification 3.6.B.2 only for the time limits specified below. Exceeding these time limits of the following maximum quality limits shall be cause for placing the reactor in the COLD SHUTDOWN CONDITION.

a. Conductivity
time above
1 $\mu\text{mho/cm}$ at 25°C -
2 weeks/year.
Maximum Limit
10 $\mu\text{mho/cm}$ at 25°C

b. Chloride
concentration time
above 0.2 ppm -
2 weeks/year.
Maximum Limit -
0.5 ppm.

c. The reactor shall be placed in the SHUTDOWN CONDITION if pH <5.6 or >8.6 for a 24-hour period.

SURVEILLANCE REQUIREMENTS

4.6.B. Coolant Chemistry

3. Whenever the reactor is operating (including HOT STANDBY CONDITION) measurements of reactor water quality shall be performed according to the following schedule:

a. Chloride ion content and pH shall be measured at least once every 96 hours.

b. Chloride ion content shall be measured at least every 8 hours whenever reactor conductivity is >1.0 $\mu\text{mho/cm}$ at 25°C.

c. A sample of reactor coolant shall be measured for pH at least once every 8 hours whenever the reactor coolant conductivity is >1.0 $\mu\text{mho/cm}$ at 25°C.

3.6/4.6 PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

3.6.B. Coolant Chemistry

4. When the reactor is not pressurized with fuel in the reactor vessel, except during the STARTUP CONDITION, the reactor water shall be maintained within the following limits.
 - a. Conductivity -
10 $\mu\text{mho/cm}$ at 25°C
 - b. Chloride - 0.5 ppm
 - c. pH shall be between
5.3 and 8.6.
5. When the time limits or maximum conductivity or chloride concentration limits are exceeded, an orderly shutdown shall be initiated immediately. The reactor shall be brought to the COLD SHUTDOWN CONDITION as rapidly as cooldown rate permits.
6. Whenever the reactor is critical, the limits on activity concentrations in the reactor coolant shall not exceed the equilibrium value of 3.2 $\mu\text{Ci/gm}$ of dose equivalent I-131.

SURVEILLANCE REQUIREMENTS

4.6.B. Coolant Chemistry

4. Whenever the reactor is not pressurized with fuel in the reactor vessel, a sample of the reactor coolant shall be analyzed at least every 96 hours for conductivity, chloride ion content and pH.
5. During equilibrium power operation an isotopic analysis, including quantitative measurements for at least I-131, I-132, I-133, and I-134 shall be performed monthly on a coolant liquid sample.
6. Additional coolant samples shall be taken whenever the reactor activity exceeds one percent of the equilibrium concentration specified in 3.6.B.6 and one of the following conditions are met:

3.6/4.6 PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

3.6.B. Coolant Chemistry

3.6.B.6 (Cont'd)

This limit may be exceeded following power transients for a maximum of 48 hours. During this activity transient the iodine concentrations shall not exceed 26 $\mu\text{Ci/gm}$ whenever the reactor is critical. The reactor shall not be operated more than 5% of its yearly power operation under this exception for the equilibrium activity limits. If the iodine concentration in the coolant exceeds 26 $\mu\text{Ci/gm}$, the reactor shall be shut down, and the steam line isolation valves shall be closed immediately.

7. When there is no fuel in the reactor vessel, technical specification reactor coolant chemistry limits do not apply.

SURVEILLANCE REQUIREMENTS

4.6.B. Coolant Chemistry

4.6.B.6 (Cont'd)

- a. During the STARTUP CONDITION
- b. Following a significant power change**
- c. Following an increase in the equilibrium off-gas level exceeding 10,000 $\mu\text{Ci/sec}$ (at the steam jet air ejector) within a 48-hour period.
- d. Whenever the equilibrium iodine limit specified in 3.6.B.6 is exceeded.

The additional coolant liquid samples shall be taken at 4 hour intervals for 48 hours, or until a stable iodine concentration below the limiting value (3.2 $\mu\text{Ci/gm}$) is established. However, at least 3 consecutive samples shall be taken in all cases. An isotopic analysis shall be performed for each sample, and quantitative measurements made to determine the dose equivalent I-131 concentration.

7. When there is no fuel in the reactor vessel, sampling of reactor coolant chemistry at technical specification frequency is not required.

** For the purpose of this section on sampling frequency, a significant power exchange is defined as a change exceeding 15% of rated power in less than 1 hour.

3.6/4.6 BASES

3.6.A/4.6.A (Cont'd)

eight studs at 70°F, which is stud NDT temperature (10°F) plus 60°F. The neutron radiation fluence at the closure flanges is well below 10^{17} nvt \geq 1 Mev; therefore, radiation effects will be minor and will not influence this temperature.

3.6.B/4.6.B Coolant Chemistry

Materials in the primary system are primarily 304 stainless steel and the Zircaloy cladding. The reactor water chemistry limits are established to prevent damage to these materials. Limits are placed on conductivity and chloride concentrations. Conductivity is limited because it is continuously measured and gives an indication of abnormal conditions and the presence of unusual materials in the coolant. Chloride limits are specified to prevent stress corrosion cracking of stainless steel.

Zircaloy does not exhibit similar stress corrosion failures. However, there are some operating conditions under which the dissolved oxygen content of the reactor coolant water could be higher than .2-.3 ppm, such as reactor startup and hot standby. During these periods, the most restrictive limits for conductivity and chlorides have been established. When steaming rates exceed 100,000 lb/hr, boiling deaerates the reactor water. This reduces dissolved oxygen concentration and assures minimal chloride-oxygen content, which together tend to induce stress corrosion cracking.

When conductivity is in its normal range, pH and chloride and other impurities affecting conductivity must also be within their normal range. When conductivity becomes abnormal, then chloride measurements are made to determine whether or not they are also out of their normal operating values. This would not necessarily be the case. Conductivity could be high due to the presence of a neutral salt which would not have an effect on pH or chloride. In such a case, high conductivity alone is not a cause for shutdown. In some types of water-cooled reactors, conductivities are in fact high due to purposeful addition of additives. In the case of BWRs, however, where no additives are used and where near neutral pH is maintained, conductivity provides a very good measure of the quality of the reactor water. Significant changes therein provide the operator with a warning mechanism so he can investigate and remedy the condition causing the change before limiting conditions, with respect to variables affecting the boundaries of the reactor coolant, are exceeded. Methods available to the operator for correcting the off-standard condition include operation of the reactor cleanup system, reducing the input of impurities and placing the reactor in the Cold Shutdown condition. The major benefit of Cold Shutdown is to reduce the temperature dependent corrosion rates and provide time for the cleanup system to reestablish the purity of the reactor coolant.

The conductivity of the reactor coolant is continuously monitored when there is fuel in the reactor vessel. Once a week the continuous monitor is checked with an in-line flow cell and is considered adequate to assure accurate readings of the monitors. If conductivity is within



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3.6/4.6 BASES

3.6.B/4.6.B (Cont'd)

its normal range, chlorides and other impurities will also be within their normal ranges. The reactor coolant samples will also be used to determine the chlorides. Therefore, the sampling frequency is considered adequate to detect long-term changes in the chloride ion content.

The basis for the equilibrium coolant iodine activity limit is a computed dose to the thyroid of 36 rem at the exclusion distance during the two-hour period following a steam line break. This dose is computed with the conservative assumption of a release of 140,000 lbs of coolant prior to closure of the isolation valves, and a X/Q value of 3.4×10^{-4} Sec/m³.

The maximum activity limit during a short term transient is established from consideration of a maximum iodine inhalation dose less than 300 rem. The probability of a steam line break accident coincident with an iodine concentration transient is significantly lower than that of the accident alone, since operation of the reactor with iodine levels above the equilibrium value is limited to 5 percent of total operation.

The sampling frequencies are established in order to detect the occurrence of an iodine transient which may exceed the equilibrium concentration limit, and to assure that the maximum coolant iodine concentrations are not exceeded. Additional sampling is required following power changes and off-gas transients, since present data indicate that the iodine peaking phenomenon is related to these events.

3.6.C/4.6.C Coolant Leakage

Allowable leakage rates of coolant from the reactor coolant system have been based on the predicted and experimentally observed behavior of cracks in pipes and on the ability to makeup coolant system leakage in the event of loss of offsite ac power. The normally expected background leakage due to equipment design and the detection capability for determining coolant system leakage were also considered in establishing the limits. The behavior of cracks in piping systems has been experimentally and analytically investigated as part of the USAEC sponsored Reactor Primary Coolant System Rupture Study (the Pipe Rupture Study). Work utilizing the data obtained in this study indicates that leakage from a crack can be detected before the crack grows to a dangerous or critical size by mechanically or thermally induced cyclic loading, or stress corrosion cracking or some other mechanism characterized by gradual crack growth. This evidence suggests that for leakage somewhat greater than the limit specified for unidentified leakage, the probability is small that imperfections or cracks associated with such leakage would grow rapidly. However, the establishment of allowable unidentified leakage greater than that given in 3.6.C on the basis of the data presently available would be premature because of uncertainties associated with the data. For leakage of the order of



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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-296

BROWNS FERRY NUCLEAR PLANT, UNIT 3

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 181
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 July 19, 1993, 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.

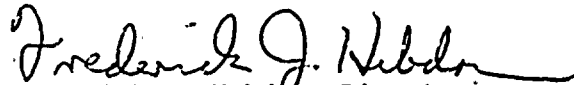
2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Facility Operating License No. DPR-68 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 181, 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 30 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Frederick J. Hebdon, Director
Project Directorate II-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: June 28, 1994

ATTACHMENT TO LICENSE AMENDMENT NO. 181

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

3.6/4.6-5
3.6/4.6-6
3.6/4.6-7
3.6/4.6-8
3.6/4.6-28
3.6/4.6-29

INSERT

3.6/4.6-5
3.6/4.6-6
3.6/4.6-7
3.6/4.6-8
3.6/4.6-28
3.6/4.6-29

3.6/4.6 PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

SURVEILLANCE REQUIREMENTS

3.6.B. Coolant Chemistry

1. PRIOR TO STARTUP and at steaming rates less than 100,000 lb/hr, the following limits shall apply.
 - a. Conductivity, $\mu\text{mho/cm}$ at 25°C 2.0
 - b. Chloride, ppm 0.1

2. At steaming rates greater than 100,000 lb/hr, the following limits shall apply.
 - a. Conductivity, $\mu\text{mho/cm}$ at 25°C 1.0
 - b. Chloride, ppm 0.2

4.6.B. Coolant Chemistry

1. Reactor coolant shall be continuously monitored for conductivity except when there is no fuel in the reactor vessel.
 - a. Whenever the continuous conductivity monitor is inoperable, a sample of reactor coolant shall be analyzed for conductivity every 4 hours except as listed below. If the reactor is in COLD SHUTDOWN CONDITION, a sample of reactor coolant shall be analyzed for conductivity every 8 hours.
 - b. Once a week the continuous monitor shall be checked with an in-line flow cell. This in-line conductivity calibration shall be performed every 24 hours whenever the reactor coolant conductivity is $>1.0 \mu\text{mho/cm}$ at 25°C.

2. During startup prior to pressurizing the reactor above atmospheric pressure, measurements of reactor water quality shall be performed to show conformance with 3.6.B.1 of limiting conditions.

3.6/4.6 PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

SURVEILLANCE REQUIREMENTS

3.6.B. Coolant Chemistry

3. At steaming rates greater than 100,000 lb/hr, the reactor water quality may exceed Specification 3.6.B.2 only for the time limits specified below. Exceeding these time limits of the following maximum quality limits shall be cause for placing the reactor in the COLD SHUTDOWN CONDITION.
- a. Conductivity time above
1 $\mu\text{mho/cm}$ at 25°C -
2 weeks/year.
Maximum Limit
10 $\mu\text{mho/cm}$ at 25°C
 - b. Chloride concentration time above 0.2 ppm -
2 weeks/year.
Maximum Limit -
0.5 ppm.
 - c. The reactor shall be placed in the SHUTDOWN CONDITION if pH <5.6 or >8.6 for a 24-hour period.

4.6.B. Coolant Chemistry

3. Whenever the reactor is operating (including HOT STANDBY CONDITION) measurements of reactor water quality shall be performed according to the following schedule:
- a. Chloride ion content and pH shall be measured at least once every 96 hours.
 - b. Chloride ion content shall be measured at least every 8 hours whenever reactor conductivity is >1.0 $\mu\text{mho/cm}$ at 25°C.
 - c. A sample of reactor coolant shall be measured for pH at least once every 8 hours whenever the reactor coolant conductivity is >1.0 $\mu\text{mho/cm}$ at 25°C.



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3.6/4.6 PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

3.6.B. Coolant Chemistry

4. When the reactor is not pressurized with fuel in the reactor vessel, except during the STARTUP CONDITION, the reactor water shall be maintained within the following limits.
 - a. Conductivity -
10 $\mu\text{mho/cm}$ at 25°C
 - b. Chloride - 0.5 ppm
 - c. pH shall be between
5.3 and 8.6.
5. When the time limits or maximum conductivity or chloride concentration limits are exceeded, an orderly shutdown shall be initiated immediately. The reactor shall be brought to the COLD SHUTDOWN CONDITION as rapidly as cooldown rate permits.
6. Whenever the reactor is critical, the limits on activity concentrations in the reactor coolant shall not exceed the equilibrium value of 3.2 $\mu\text{Ci/gm}$ of dose equivalent I-131.

SURVEILLANCE REQUIREMENTS

4.6.B. Coolant Chemistry

4. Whenever the reactor is not pressurized with fuel in the reactor vessel, a sample of the reactor coolant shall be analyzed at least every 96 hours for conductivity, chloride ion content and pH.
5. During equilibrium power operation an isotopic analysis, including quantitative measurements for at least I-131, I-132, I-133, and I-134 shall be performed monthly on a coolant liquid sample.
6. Additional coolant samples shall be taken whenever the reactor activity exceeds one percent of the equilibrium concentration specified in 3.6.B.6 and one of the following conditions are met:



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3.6/4.6 PRIMARY SYSTEM BOUNDARY

LIMITING CONDITIONS FOR OPERATION

3.6.B. Coolant Chemistry

3.6.B.6 (Cont'd)

This limit may be exceeded following power transients for a maximum of 48 hours. During this activity transient the iodine concentrations shall not exceed 26 $\mu\text{Ci/gm}$ whenever the reactor is critical. The reactor shall not be operated more than 5% of its yearly power operation under this exception for the equilibrium activity limits. If the iodine concentration in the coolant exceeds 26 $\mu\text{Ci/gm}$, the reactor shall be shut down, and the steam line isolation valves shall be closed immediately.

7. When there is no fuel in the reactor vessel, technical specification reactor coolant chemistry limits do not apply.

SURVEILLANCE REQUIREMENTS

4.6.B. Coolant Chemistry

4.6.B.6 (Cont'd)

- a. During the STARTUP CONDITION
- b. Following a significant power change**
- c. Following an increase in the equilibrium off-gas level exceeding 10,000 $\mu\text{Ci/sec}$ (at the steam jet air ejector) within a 48-hour period.
- d. Whenever the equilibrium iodine limit specified in 3.6.B.6 is exceeded.

The additional coolant liquid samples shall be taken at 4 hour intervals for 48 hours, or until a stable iodine concentration below the limiting value (3.2 $\mu\text{Ci/gm}$) is established. However, at least 3 consecutive samples shall be taken in all cases. An isotopic analysis shall be performed for each sample, and quantitative measurements made to determine the dose equivalent I-131 concentration.

7. When there is no fuel in the reactor vessel, sampling of reactor coolant chemistry at technical specification frequency is not required.

** For the purpose of this section on sampling frequency, a significant power exchange is defined as a change exceeding 15% of rated power in less than 1 hour.

3.6/4.6 BASES

3.6.A/4.6.A (Cont'd)

eight studs at 70°F, which is stud NDT temperature (10°F) plus 60°F. The neutron radiation fluence at the closure flanges is well below 10^{17} nvt \geq 1 Mev; therefore, radiation effects will be minor and will not influence this temperature.

3.6.B/4.6.B Coolant Chemistry

Materials in the primary system are primarily 304 stainless steel and the Zircaloy cladding. The reactor water chemistry limits are established to prevent damage to these materials. Limits are placed on conductivity and chloride concentrations. Conductivity is limited because it is continuously measured and gives an indication of abnormal conditions and the presence of unusual materials in the coolant. Chloride limits are specified to prevent stress corrosion cracking of stainless steel.

Zircaloy does not exhibit similar stress corrosion failures. However, there are some operating conditions under which the dissolved oxygen content of the reactor coolant water could be higher than .2-.3 ppm, such as reactor startup and hot standby. During these periods, the most restrictive limits for conductivity and chlorides have been established. When steaming rates exceed 100,000 lb/hr, boiling deaerates the reactor water. This reduces dissolved oxygen concentration and assures minimal chloride-oxygen content, which together tend to induce stress corrosion cracking.

When conductivity is in its normal range, pH and chloride and other impurities affecting conductivity must also be within their normal range. When conductivity becomes abnormal, then chloride measurements are made to determine whether or not they are also out of their normal operating values. This would not necessarily be the case. Conductivity could be high due to the presence of a neutral salt which would not have an effect on pH or chloride. In such a case, high conductivity alone is not a cause for shutdown. In some types of water-cooled reactors, conductivities are in fact high due to purposeful addition of additives. In the case of BWRs, however, where no additives are used and where near neutral pH is maintained, conductivity provides a very good measure of the quality of the reactor water. Significant changes therein provide the operator with a warning mechanism so he can investigate and remedy the condition causing the change before limiting conditions, with respect to variables affecting the boundaries of the reactor coolant, are exceeded. Methods available to the operator for correcting the off-standard condition include operation of the reactor cleanup system, reducing the input of impurities and placing the reactor in the Cold Shutdown condition. The major benefit of Cold Shutdown is to reduce the temperature dependent corrosion rates and provide time for the cleanup system to reestablish the purity of the reactor coolant.

The conductivity of the reactor coolant is continuously monitored when there is fuel in the reactor vessel. Once a week the continuous monitor is checked with an in-line flow cell and is considered adequate to assure accurate readings of the monitors. If conductivity is within



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3.6/4.6 BASES

3.6.B/4.6.B (Cont'd)

its normal range, chlorides and other impurities will also be within their normal ranges. The reactor coolant samples will also be used to determine the chlorides. Therefore, the sampling frequency is considered adequate to detect long-term changes in the chloride ion content.

The basis for the equilibrium coolant iodine activity limit is a computed dose to the thyroid of 36 rem at the exclusion distance during the two-hour period following a steam line break. This dose is computed with the conservative assumption of a release of 140,000 lbs of coolant prior to closure of the isolation valves, and a X/Q value of 3.4×10^{-4} Sec/m³.

The maximum activity limit during a short term transient is established from consideration of a maximum iodine inhalation dose less than 300 rem. The probability of a steam line break accident coincident with an iodine concentration transient is significantly lower than that of the accident alone, since operation of the reactor with iodine levels above the equilibrium value is limited to 5 percent of total operation.

The sampling frequencies are established in order to detect the occurrence of an iodine transient which may exceed the equilibrium concentration limit, and to assure that the maximum coolant iodine concentrations are not exceeded. Additional sampling is required following power changes and off-gas transients, since present data indicate that the iodine peaking phenomenon is related to these events.

3.6.C/4.6.C Coolant Leakage

Allowable leakage rates of coolant from the reactor coolant system have been based on the predicted and experimentally observed behavior of cracks in pipes and on the ability to makeup coolant system leakage in the event of loss of offsite ac power. The normally expected background leakage due to equipment design and the detection capability for determining coolant system leakage were also considered in establishing the limits. The behavior of cracks in piping systems has been experimentally and analytically investigated as part of the USAEC sponsored Reactor Primary Coolant System Rupture Study (the Pipe Rupture Study). Work utilizing the data obtained in this study indicates that leakage from a crack can be detected before the crack grows to a dangerous or critical size by mechanically or thermally induced cyclic loading, or stress corrosion cracking or some other mechanism characterized by gradual crack growth. This evidence suggests that for leakage somewhat greater than the limit specified for unidentified leakage, the probability is small that imperfections or cracks associated with such leakage would grow rapidly. However, the establishment of allowable unidentified leakage greater than that given in 3.6.C on the basis of the data presently available would be premature because of uncertainties associated with the data. For leakage of the order of five gpm, as specified in 3.6.C, the experimental and analytical data



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