November 15, 1989

Docket Nos: 50-254
and 50-265

Mr. Thomas J. Kovach
Director of Nuclear Licensing
Commonwealth Edison Company
Post Office Box 767
Chicago, Illinois 60690

Dear Mr. Kovach:

SUBJECT: HPCI & RCIC SYSTEMS HIGH AREA TEMPERATURE ISOLATION TECHNICAL SPECIFICATION AMENDMENT (TAC NOS. 74164 AND 74165)

The Commission has issued the enclosed Amendment Nos. 121 and 117 to Facility Operating License Nos. DPR-29 and DPR-30 for the Quad Cities Nuclear Power Station, Units 1 and 2. These Technical Specifications (TS) amendments are in response to your application dated August 3, 1989.

These amendments reduce the number and decrease the setpoint of temperature switches which initiate system isolation for the High Pressure Coolant (HPCI) and Reactor Core Isolation Cooling (RCIC) systems. HPCI and RCIC system isolation temperature switches are being modified to limit spurious actuations caused by minor steam leaks. Consequently, TS were revised to support future HPCI and RCIC system operations.

A copy of our related Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly Federal Register notices.

Sincerely,

/s/
Thierry Ross, Project Manager
Project Directorate III-2
Division of Reactor Projects - III
IV, V and Special Projects

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P PNU

Enclosures:
1. Amendment No. 121 to License No. DPR-29
2. Amendment No. 117 to License No. DPR-30
3. Safety Evaluation

cc w/enclosures:
See next page

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Document Name: LICENSE NO. DPR29

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

November 15, 1989

Docket Nos: 50-254
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Director of Nuclear Licensing
Commonwealth Edison Company
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These amendments reduce the number and decrease the setpoint of temperature switches which initiate system isolation for the High Pressure Coolant (HPCI) and Reactor Core Isolation Cooling (RCIC) systems. HPCI and RCIC system isolation temperature switches are being modified to limit spurious actuations caused by minor steam leaks. Consequently, TS were revised to support future HPCI and RCIC system operations.

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Thierry Ross, Project Manager
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Division of Reactor Projects - III
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See next page

Mr. Thomas J. Kovach
Commonwealth Edison Company

Quad Cities Nuclear Power Station
Units 1 and 2

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

COMMONWEALTH EDISON COMPANY

AND

IOWA-ILLINOIS GAS AND ELECTRIC COMPANY

DOCKET NO. 50-254

QUAD CITIES NUCLEAR POWER STATION, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 121
License No. DPR-29

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

   A. The application for amendment by Commonwealth Edison Company (the licensee) dated August 3, 1989, 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 regulation 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 3.B. of Facility Operating License No. DPR-29 is hereby amended to read as follows:

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B. Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 121 , 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 the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

John W. Craig, Director
Project Directorate III-2
Division of Reactor Projects - III,
IV, V and Special Projects

Attachment:
Changes to the Technical
Specifications

Date of Issuance: November 15, 1989

ATTACHMENT TO LICENSE AMENDMENT NO. 121

FACILITY OPERATING LICENSE NO. DPR-29

DOCKET NO. 50-254

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

REMOVE	INSERT
3.2/4.2-8	3.2/4.2-8
3.2/4.2-15	3.2/4.2-15

setting of 140% of rated steam flow, in conjunction with the flow limiters and main steamline valve closure, limits the mass inventory loss such that fuel is not uncovered, fuel temperatures remain less than 1500°F, and release of radioactivity to the environs is well below 10 CFR 100 guidelines (reference SAR Sections 14.2.3.9 and 14.2.3.10).

Temperature monitoring instrumentation is provided in the main steamline tunnel to detect leaks in this area. Trips are provided on this instrumentation and when exceeded cause closure of Group 1 isolation valves. Its setting of 200°F is low enough to detect leaks of the order of 5 to 10 gpm; thus it is capable of covering the entire spectrum of breaks. For large breaks, it is a backup to high-steam flow instrumentation discussed above, and for small breaks with the resulting small release of radioactivity, gives isolation before the guidelines of 10 CFR 100 are exceeded.

High radiation monitors in the main steamline tunnel have been provided to detect gross fuel failure. This instrumentation causes closure of Group 1 valves, the only valves required to close for this accident. With the established setting of 15 times normal background (without hydrogen addition) and main steamline isolation valve closure, fission product release is limited so that 10 CFR 100 guidelines are not exceeded for this accident (reference SAR Section 14.2.1.7).

Pressure instrumentation is provided which trips when main steamline pressure drops below 825 psig. A trip of this instrumentation results in closure of Group 1 isolation valves. In the Refuel and Startup/Hot Standby modes this trip function is bypassed. This function is provided primarily to provide protection against a pressure regulator malfunction which would cause the control and/or bypass valve to open. With the trip set at 825 psig, inventory loss is limited so that fuel is not uncovered and peak cladding temperatures are much less than 1500°F; thus, there are no fission products available for release other than those in the reactor water (reference SAR Section 11.2.3).

The RCIC and the HPCI high flow and temperature instrumentation are provided to detect a break in their respective piping. Tripping of this instrumentation results in actuation of the RCIC or of HPCI isolation valves. Tripping logic for this function is the same as that for the main steamline isolation valves, thus all sensors are required to be operable or in a tripped condition to meet single-failure criteria. The trip settings of 170°F and 300% of design flow and valve closure time are such that core uncovery is prevented and fission product release is within limits.

TABLE 3.2-1

INSTRUMENTATION THAT INITIATES PRIMARY CONTAINMENT ISOLATION FUNCTIONS

Minimum Number of Operable or Tripped Instrument Channels [1]	Instruments	Trip Level Setting	Action[2]
4	Reactor low water[5]	>144 inches above top of active fuel*	A
4	Reactor low low water	≥84 inches above top of active fuel*	A
4	High drywell pressure[5]	≤2.5 psig [3]	A
16	High flow main steamline[5]	≤140% of rated steam flow	B
16	High temperature main steamline tunnel	≤200°F	B
4	High radiation main steamline tunnel[6]	≤15 x normal rated power background (without hydrogen addition)	B
4	Low main steam pressure[4]	≥825 psig	B
2	High flow RCIC steamline	≤300% of rated steam flow[7]	C
4	RCIC turbine area high temperature	≤170°F	C
2	High flow HPCI steamline	≤300% of rated steam flow[7]	D
4	HPCI area high temperature	≤170°F	D

Notes

[1] Whenever primary containment integrity is required, there shall be two operable or tripped systems for each function, except for low pressure main steamline which only need be available in the Run position.

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

COMMONWEALTH EDISON COMPANY

AND

IOWA-ILLINOIS GAS AND ELECTRIC COMPANY

DOCKET NO. 50-265

QUAD CITIES NUCLEAR POWER STATION, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 117
License No. DPR-30

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

   A. The application for amendment by Commonwealth Edison Company (the licensee) dated August 3, 1989, 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 regulation 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 3.B. of Facility Operating License No. DPR-30 is hereby amended to read as follows:

B. Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 117 , 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 April 15, 1990.

FOR THE NUCLEAR REGULATORY COMMISSION

John W. Craig, Director
Project Directorate III-2
Division of Reactor Projects - III,
IV, V and Special Projects

Attachment:
Changes to the Technical
Specifications

Date of Issuance: November 15, 1989

ATTACHMENT TO LICENSE AMENDMENT NO. 117

FACILITY OPERATING LICENSE NO. DPR-30

DOCKET NO. 50-265

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

REMOVE	INSERT
3.2/4.2-6	3.2/4.2-6
	3.2/4.2-6a
3.2/4.2-11	3.2/4.2-11

Venturi tubes are provided in the main steamlines as a means of measuring steam flow and also limiting the loss of mass inventory from the vessel during a steamline break accident. In addition to monitoring steam flow, instrumentation is provided which causes a trip of Group 1 isolation valves. The primary function of the instrumentation is to detect a break in the main steamline, thus only Group 1 valves are closed. For the worst-case accident, main steamline break outside the drywell, this trip setting of 140% of rated steam flow, in conjunction with the flow limiters and main steamline valve closure, limits the mass inventory loss such that fuel is not uncovered, fuel temperatures remain less than 1500°F, and release of radioactivity to the environs is well below 10 CFR 100 guidelines (reference SAR Sections 14.2.3.9 and 14.2.3.10).

Temperature monitoring instrumentation is provided in the main steamline tunnel to detect leaks in this area. Trips are provided on this instrumentation and when exceeded cause closure of Group 1 isolation valves. Its setting of 200°F is low enough to detect leaks of the order of 5 to 10 gpm; thus it is capable of covering the entire spectrum of breaks. For large breaks, it is a backup to high-steam flow instrumentation discussed above, and for small breaks with the resulting small release of radioactivity, gives isolation before the guidelines of 10 CFR 100 are exceeded.

High radiation monitors in the main steamline tunnel have been provided to detect gross fuel failure. This instrumentation causes closure of Group 1 valves, the only valves required to close for this accident. With the established setting of 15 times normal background (without hydrogen addition) and main steamline isolation valve closure, fission product release is limited so that 10 CFR 100 guidelines are not exceeded for this accident (reference SAR Section 14.2.1.7).

Pressure instrumentation is provided which trips when main steamline pressure drops below 825 psig. A trip of this instrumentation results in closure of Group 1 isolation valves. In the Refuel and Startup/Hot Standby modes this trip function is bypassed. This function is provided primarily to provide protection against a pressure regulator malfunction which would cause the control and/or bypass valve to open. With the trip set at 825 psig, inventory loss is limited so that fuel is not uncovered and peak cladding temperatures are much less than 1500°F; thus, there are no fission products available for release other than those in the reactor water (reference SAR Section 11.2.3).

The RCIC and the HPCI high flow and temperature instrumentation are provided to detect a break in their respective piping. Tripping of this instrumentation results in actuation of the RCIC or of HPCI isolation valves. Tripping logic for this function is the same as that for the main steamline isolation valves, thus all sensors are required to be operable or in a tripped condition to meet single-failure criteria. The trip settings of 170°F and 300% of design flow and valve closure time are such that core uncovery is prevented and fission product release is within limits.

The instrumentation which initiates ECCS action is arranged in a one-out-of-two taken twice logic circuit. Unlike the reactor scram circuits, however, there is one trip system associated with each function rather than the two trip systems in the reactor protection system. The single-failure criteria are met by virtue of the fact that redundant core cooling functions are provided, e.g., sprays and automatic blowdown and high-pressure coolant injection. The specification requires that if a trip system becomes inoperable, the system which it activates is declared inoperable. For example, if the trip system for core spray A becomes inoperable, core spray A is declared inoperable and the out-of-service specifications of Specification 3.5 govern. This specification preserves the effectiveness of the system with respect to the single-failure criteria even during periods when maintenance or testing is being performed.

The control rod block functions are provided to prevent excessive control rod withdrawal so that MCPR does not go below the MCPR Fuel Cladding Integrity Safety Limit. The trip logic for this function is one out of n; e.g., any trip on one of the six APRM's, eight IRM's, four SRM's will result in a rod block. The minimum instrument channel requirements assure sufficient instrumentation to assure that the single-failure criteria are met. The minimum instrument channel requirements for the RBM may be reduced by one for a short period of time to allow for maintenance, testing, or calibration. This time period is only ~ 3% of the operating time in a month and does not significantly increase the risk of preventing an inadvertent control rod withdrawal.

TABLE 3.2-1

INSTRUMENTATION THAT INITIATES PRIMARY CONTAINMENT ISOLATION FUNCTIONS

Minimum Number of Operable or Tripped Instrument Channels[1]	Instruments	Trip Level Setting	Action[2]
4	Reactor low water[5]	>144 inches above top of active fuel*	A
4	Reactor low low water	≥84 inches above top of active fuel*	A
4	High drywell pressure[5]	≤2.5 psig [3]	A
16	High flow main steamline[5]	≤140% of rated steam flow	B
16	High temperature main steamline tunnel	≤200° F	B
4	High radiation main steamline tunnel[6]	≤15 x normal rated power background (without hydrogen addition)	B
4	Low main steam pressure[4]	≥825 psig	B
2	High flow RCIC steamline	≤300 % of rated steam flow(7)	C
4	RCIC turbine area high temperature	≤170° F	C
2	High flow HPCI steamline	≤300% of rated steam flow(7)	D
4	HPCI area high temperature	≤170° F	D

Notes

1. Whenever primary containment integrity is required, there shall be two operable or tripped systems for each function, except for low pressure main steamline which only need be available in the Run position.

2. Action, if the first column cannot be met for one of the trip systems, that trip system shall be tripped.

   If the first column cannot be met for both trip systems, the appropriate actions listed below shall be taken.

   A. Initiate an orderly shutdown and have the reactor in Cold Shutdown condition in 24 hours.

   B. Initiate an orderly load reduction and have reactor in Hot Standby within 8 hours.

   C. Close isolation valves in RCIC system.

   D. Close isolation valves in HPCI subsystem.

3. Need not be operable when primary containment integrity is not required.

4. The isolation trip signal is bypassed when the mode switch is in Refuel or Startup/Hot Shutdown.

5. The instrumentation also isolates the control room ventilation system.

6. This signal also automatically closes the mechanical vacuum pump discharge line isolation valves.

7. Includes a time delay of $3 \leq t \leq 9$ seconds.

*Top of active fuel is defined as 360" above vessel zero for all water levels used in the LOCA analysis (see Bases 3.2).

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 121 TO FACILITY OPERATING LICENSE NO. DPR-29

AND AMENDMENT NO. 117 TO FACILITY OPERATING LICENSE NO. DPR-30

COMMONWEALTH EDISON COMPANY

AND

IOWA-ILLINOIS GAS AND ELECTRIC COMPANY

QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2

DOCKET NOS. 50-254/265

1.0 INTRODUCTION

In the past, spurious isolations of the High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) systems at the Quad Cities Nuclear Power Station (QCNPS) have occurred from minor steam leaks during system startups due to the proximity of room area temperature switches. Commonwealth Edison Company (CECo) plans to modify the location and number of temperature switch groups in the HPCI and RCIC rooms at QCNPS to maximize system reliability (i.e. minimize probability of spurious isolations) and yet still maintain the capability to adequately sense bulk room temperature during an actual main steam (MS) supply line break. The purpose of high area temperature switches in the HPCI and RCIC rooms is to isolate the MS supply from containment for these systems in the event of a steamline break. Revised QCNPS Technical Specifications (TS) are necessary to reflect planned system modifications.

Currently TS Table 3.2-1, "Instrumentation That Initiates Primary Containment Isolation Functions," requires a minimum of sixteen (16) operable or tripped instrument channels for the HPCI and RCIC high area temperature isolation functions. The trip level setting of these systems is less than or equal to 200°F. By letter dated August 3, 1989, CECo proposed to amend the QCNPS TS to reduce the required number of operable temperature switches for primary containment isolation of the HPCI and RCIC systems from sixteen channels to four, and to lower the high area temperature trip setpoint from 200°F to 170°F. The temperature trip setpoint for MS supply line containment isolation also needs to be lowered in order to compensate for the reduced number of temperature switches so that HPCI/RCIC system isolation response time is not adversely effected.

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2.0 EVALUATION

Commonwealth Edison Company proposed to amend applicable TS to support the upcoming modification of the HPCI and RCIC room area temperature monitoring systems. The HPCI and RCIC systems have two (2) diverse containment isolation design features. Containment isolation is actuated on high flow or high area temperature. The high flow isolation was designed to assure system isolation in the event of a large steamline break. The high area temperature isolation is designed to assure isolation occurs for smaller steamline breaks. Modification of the room area temperature switches is necessary to preclude spurious isolation actuations occurring from minor steam leaks at the inboard and outboard turbine gland seals on both the HPCI and RCIC systems.

The existing room temperature monitoring system for each of the HPCI and RCIC rooms consists of sixteen (16) temperature switches configured in four groups of four. The location of the temperature switch groups for the HPCI system is above the HPCI steam inlet line, above the turbine rupture disk, and one group at each end of the turbine near the bearings. The RCIC system temperature switches are located at the rupture disk, near the steam supply to the turbine and at both ends of the turbine at the shaft. Actuation of any two switches at any one location would isolate the system. In the past, this resulted in spurious system isolations from minor steam leaks at the turbine gland seals. These kind of expected leaks are negligible when compared to the steam leakage anticipated for actual steamline breaks. Consequently, the current temperature monitoring configuration seems to provide excessive sensitivity to local room hot spots which are not necessarily indicative of a steamline break.

Modification of the Unit 1 temperature switches in the HPCI and RCIC rooms is being accomplished during the Unit 1 refueling outage from September to December 1989. This same modification for Unit 2 is planned for its refueling outage scheduled to begin February 1990. Revised TS are necessary to support restart of both units.

The modified configuration of HPCI/RCIC room area temperature switches will consist of a total of four switches with two switches installed at the steam inlet piping and two switches installed at the turbine exhaust rupture diaphragm for each system. The locations of the switches are intended to maximize system reliability and reduce the probability of spurious isolations. Calculations performed to justify reducing the number of temperature switches are based on bulk room temperature; therefore, these switches will be centrally located in both rooms for sensing temperatures related to steamline breaks. The four switches will retain the one-out-of-two taken twice trip logic and will maintain divisional power supplies. In addition, the requirement that all instruments be operable or in the tripped conditions has been retained. The two locations will minimize the potential for spurious isolations due to minor steam leakage at the turbine gland seals yet adequately sense changes in bulk room temperature associated with an actual steamline break. The modification should increase the reliability of

the HPCI and RCIC systems by eliminating spurious isolations due to minor steam leaks. HPCI/RCIC Room Leak Detection Analyses conducted and by the General Electric (GE) Company (enclosed in the CECo submittal) recommended reducing the number of temperature switches.

The trip level setpoint will be lowered to ensure adequate system response time and to ensure radiation releases are maintained within 10 CFR Part 100 limits. The new trip level setting for high room area temperature will be less than or equal to 170°F. This setting was verified to be conservative by calculations performed by Impell (enclosed in CECo submittal). The Impell calculations are based on the aforementioned analyses by General Electric which correlated the size of the steam leak to the change in bulk room temperature. The purpose of Impell's calculations was to justify the temperature switch setpoint for HPCI/RCIC room steamline isolation system. The reduction in the number of switches changes the function of the temperature measurement from localized to bulk room temperature determination. This change in parameter measurement creates a need for a temperature setpoint change to ensure adequate system time response to steam leaks. These calculations confirmed that a trip level setting of less than or equal to 170°F will ensure an adequate system response time while maintaining a low incidence of spurious isolation actuation.

The bounding event for a loss of primary coolant outside containment is the Main Steamline break, as discussed in the bases for Quad Cities Technical Specification 3.7/4.7. The Main Steamline Break is analyzed in section 14.2.3 of the Quad Cities Final Safety Analysis Report. The analysis indicates that 85,000 pounds of primary coolant inventory is lost during the Main Steamline break. The break does not result in core uncovery and the resulting offsite dose limits are well below 10 CFR Part 100 limits.

In order to assess the adequacy of the response time associated with the proposed setpoint, an analysis of the total mass loss for a spectrum of leak rates from 5 to 50 gallons per minute was performed. The HPCI system isolation was the more limiting case since the RCIC compartment is smaller in size, thereby, the temperature increases and associated isolation would occur faster. The largest mass loss calculated for a HPCI leak before the isolation was 2400 pounds of coolant inventory. Since the mass loss is significantly less than that lost during the bounding Main Steamline break, the resulting radiological dose will be a small fraction of 10 CFR Part 100 limits.

The purpose of the RCIC and HPCI system isolation is to assure system isolation in the event of a steamline break to prevent inventory loss and maintain radiation does to less than 10 CFR Part 100 limits. The modified system will maintain separation criteria for electric power supplies. The one-out-of-two taken twice trip logic will be retained so that the isolation capability is maintained in the event of single switch failure. A large steam leak resulting from the rupture of the RCIC and HPCI steam supply line would

cause the high flow instrumentation to provide a trip of the isolation logic. For smaller leaks, the bulk room temperature of the HPCI or RCIC rooms would increase thus resulting in the actuation of the temperature isolation feature. Reducing the number of temperature switches is compensated by lowering, in the conservative direction, the temperature isolation setpoint which will assure adequate system response. This modification remains consistent with the original General Electric Design Specifications. Furthermore, the current high flow isolation, accompanied by the modified temperature isolation, assures that only a minimal inventory loss occurs, thus preventing core uncovery and ensuring that 10 CFR Part 100 requirements are not exceeded. Consequently, the staff concludes that the planned modifications and proposed TS changes are acceptable.

3.0 ENVIRONMENTAL CONSIDERATION

These amendments involve changes to requirements with respect to the installation and use of facility component located within the restricted area as defined in 10 CFR Part 20. The staff has determined that these 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, these 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 staff concluded, based on the considerations discussed above, that: (1) there is reasonable assurance the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of these amendments will not be inimical to the common defense and security nor to the health and safety of the public.

Principal Contributor: Thierry M. Ross

Dated: November 15, 1989