September 12, 2000

Mr. S. E. Scace - Director
Nuclear Oversight and Regulatory Affairs
c/o Mr. David A. Smith
Northeast Nuclear Energy Company
P. O. Box 128
Waterford, CT 06385-0128

SUBJECT: MILLSTONE NUCLEAR POWER STATION, UNIT NO. 3 - ISSUANCE OF AMENDMENT RE: FULL-CORE OFFLOAD (TAC NO. MA4586)

Dear Mr. Scace:

The Commission has issued the enclosed Amendment No. 182 to Facility Operating License No. NPF-49 for the Millstone Nuclear Power Station, Unit No. 3 (Millstone 3) in response to your application dated January 18, 1999, as supplemented by letters dated April 5 and December 21, 1999; and May 2 and August 10, 2000.

The amendment revises the Technical Specifications (TSs) and the Final Safety Analysis Report for Millstone 3 to allow an entire reactor core to be offloaded to the spent fuel pool (SFP) and an increase in the maximum design basis normal SFP water temperature limit from 140 ^{o}F to 150 ^{o}F during planned refueling outages.   The increase in maximum design basis normal SFP water temperature up to 150 $^{\circ}$F affects certain Fuel Building area TS temperature limits that required a revision to the TSs.

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

Sincerely,

/RA/

Victor Nerses, Sr. Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-423

Enclosures: 1. Amendment No. 182 to NPF-49
2. Safety Evaluation

cc w/encls: See next page

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NORTHEAST NUCLEAR ENERGY COMPANY, ET AL.

DOCKET NO. 50-423

MILLSTONE NUCLEAR POWER STATION, UNIT NO. 3

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 182
License No. NPF-49

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

   A. The application for amendment by Northeast Nuclear Energy Company, et al. (the licensee) dated January 18, 1999, as supplemented by letters dated April 5 and December 21, 1999; and May 2 and August 10, 2000, 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. NPF-49 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 182 , and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of issuance, and shall be implemented within 90 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

James W. Clifford, Chief, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical
Specifications

Date of Issuance: September 12, 2000

ATTACHMENT TO LICENSE AMENDMENT NO. 182

FACILITY OPERATING LICENSE NO. NPF-49

DOCKET NO. 50-423

Replace the following page of the Appendix A Technical Specifications, with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

Remove	Insert
3/4 7-35	3/4 7-35

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 182

TO FACILITY OPERATING LICENSE NO. NPF-49

NORTHEAST NUCLEAR ENERGY COMPANY, ET AL.

MILLSTONE NUCLEAR POWER STATION, UNIT NO. 3

DOCKET NO. 50-423

1.0 INTRODUCTION

By letter dated January 18, 1999, as supplemented by letters dated April 5 and December 21, 1999; and May 2 and August 10, 2000, the licensee (Northeast Nuclear Energy Company) of Millstone Nuclear Power Station, Unit 3 (MNPS-3) requested an amendment to Facility Operating License No. NPF-49. The amendment proposed changes to the Technical Specifications (TSs) and Final Safety Analysis Report (FSAR) to allow an entire reactor core to be offloaded to the spent fuel pool (SFP) and an increase in the maximum design basis SFP water temperature limit from 140 °F to 150 °F during routine (planned) refueling outages. The increase in maximum design basis normal SFP water temperature up to 150 °F affects certain Fuel Building area TS temperature limits that required a revision to the TSs. The letters dated April 5 and December 21, 1999; and May 2 and August 10, 2000, provided clarifying information and did not change the staff's initial proposed no significant hazards consideration determination or expand the scope of the application as published in the Federal Register.

2.0 BACKGROUND

Originally, a full-core offload at MNPS-3 was thought to be necessary for only a small number of occurrences (e.g., for periodic inservice inspection (ISI) of the reactor vessel, for an emergency during an operating cycle involving fuel failure or core damage, and for defueling the reactor during the final end-of-cycle (EOC) refueling outage). Therefore, with only a limited number of occurrences anticipated, a full-core offload was categorized as an abnormal event. The licensee has since determined that offloading an entire core into the SFP during a refueling outage is a desirable practice. It provides greater maintenance flexibility and can enhance safety during an outage. Considering these benefits, the licensee proposed to change the licensing basis to allow an entire core to be offloaded into the SFP during a planned refueling outage and, subsequently, to allow an increase in SFP water temperature limit from 140 °F to 150 °F.

In order to render the thermal-hydraulic analyses independent of a particular operating/refueling cycle, the analyses performed by the licensee's contractor (Holtec International) and submitted with this proposed amendment assume that the SFP inventory corresponds to the end of the licensed life of the MNPS-3 reactor. The heat load in the MNPS-3 SFP is maximized by assuming a theoretical maximum quantity of fuel stored in the SFP from previous discharges. The licensee's approach includes consideration of the potential maximum number of spent fuel assemblies (SFAs) that could result from the proposed amendment request to increase spent fuel pool storage by adding racks, dated March 19, 1999. In that proposed SFP license amendment request, the licensee proposed adding high density storage racks to increase the SFP storage capacity from 756 to 1860 SFAs. That proposed SFP amendment is being evaluated separately.

The following evaluation covers the applicable areas of the licensee's submittal, including the information supplied in letters dated April 5 and December 21, 1999; and May 2 and August 10, 2000, responding to the staff's Request for Additional Information (RAI).

3.0 EVALUATION

3.1 Spent Fuel Pool Cooling

The SFP cooling and cleaning system (SFPCCS), which contains two subsystems (spent fuel pool cooling system and spent fuel pool cleaning system), is designed to remove the decay heat from the SFAs stored in the SFP, and to clarify and purify the water in the SFP, fuel transfer canal, and refueling water storage tank. The cleaning system portion of the SFPCCS can be isolated by manual valves from the spent fuel pool cooling system (SFPCS) portion of the SFPCCS.

The SFPCS consists of two 100% capacity, Safety Class 3, and Seismic Category 1 cooling trains each equipped with one heat exchanger and one pump. Heat is removed from the SFP heat exchangers by the component cooling water system (CCWS).[1] The SFPCS was initially designed to:

a) Maintain the SFP water temperature during routine (planned) refueling outages at or below 140 °F with one SFPCS train operating to remove decay heat from one-half of the reactor core (about 96 SFAs) discharged to the SFP in addition to the decay heat from the previous (up to and including Cycle 20) refueling discharges.

b) Maintain the SFP water temperature during an abnormal (unplanned) full-core offload outage at or below 150 °F with one SFPCS train operating to remove decay heat from a full core discharged into the SFP in addition to the decay heat from the previous (up to the last plant operating cycle) refueling discharges.

c) Maintain the SFP water temperature at or below 200 °F following a design basis accident (DBA) with a loss of off-site power (LOOP) resulting in a loss of SFP cooling for 4 hours.

Discharge of a full core to the SFP during a planned refueling outage results in an increase in the decay heat generated in the SFP over that generated by a half core. Also, the proposed increase in SFP storage capacity results in an additional increase in the decay heat load for any

[1] The heat removal rate of the SFPCS heat exchanger is a function of the component cooling water temperatures.

specific fuel discharge scenario. Holtec International performed the thermal-hydraulic analyses to evaluate the effects of these increases in decay heat on the SFPCC system and SFP water temperatures. The licensee performed revised thermal-hydraulic analyses using the DECOR computer code based on the ORIGEN2 computer code, which was developed by Oak Ridge National Laboratory (ORNL) for decay heat calculation. To conservatively estimate the decay heat, the licensee made the following assumptions in the analyses to maximize the decay heat generated in the SFP:

a. 2855 SFAs[2] from previous discharges would be stored in the SFP prior to a final full-core (193 SFAs) discharge at a rate of three SFAs per hour into the SFP and with one SFCS train cooling the SFP. A total of 3048 SFAs (as opposed to the current assumed 2169 SFAs), which exceeds the proposed storage capacity (1860 SFAs) of the SFP, were assumed to be stored in the SFP.

b. 60,000 MWD/MTU average burn-up as bounding burn-up for all discharges.

c. One year operation at full power before a planned full-core discharge.

d. Additionally, 1088 SFAs with 10 years of decay (at maximum 60,000 MWD/MTU average burn-up) are conservatively assumed to be stored in the SFP.

e. For an unplanned full-core discharge, 36 days of full power operation is assumed after start-up from the previous outage. The unplanned full-core offload occurs at the start of the plant's projected final fuel cycle to maximize the amount of background decay heat in the SFP.

The licensee stated that the decay heat from the SFAs discharged to the SFP as a result of the unplanned full-core offload is bounded by the decay heat of the SFAs from the end of plant life (planned) full-core offload. The decay heat from the unplanned full-core offload during the final cycle is less than that from the end of plant life full-core offload because the burnup associated with the unplanned full-core offload is lower. Therefore, the planned full-core offload thermal hydraulic analyses as presented in this licensing amendment request bound the unplanned full-core offload and are the limiting scenarios for the demonstration of thermal-hydraulic adequacy of the SFPCS.

For any full-core offload scenario, in order to maintain the SFP water at or below the proposed temperature limit of 150 °F, SFAs must be held in the reactor vessel for a minimum period of time after reactor shutdown prior to being discharged to the SFP. In any event, SFAs may not be discharged into the SFP prior to a minimum shutdown time of 100 hours.[3] Since the heat removal capability of the SFPCS is a function of CCWS water temperature, the licensee performed analyses to establish reactor shutdown time required prior to the discharge of SFAs from the reactor vessel for CCWS water temperatures at 80 °F, 85 °F, 90 °F, and 95 °F with one SFPCS train cooling the SFP. The following summarizes the results of the analysis:

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[2] Including the 1088 SFAs as described in item d and 1767 SFAs from previous discharges.

[3] MNPS-3 TSs require a minimum in-reactor vessel hold time of 100 hours.

CCWS Water Temp. (°F)	Reactor Shutdown Time Required (hours)	Peak SFP Temperature (°F)	Coincident Time After Reactor Shutdown (hours)[4]	Coincident Pool Heat Load (10^6BTU/hr)	Time to Boil (hours)
80	101 [5]	148.31	176	44.38	5.47
85	142	148.56	218	41.47	5.89
90	200	148.77	277	38.53	6.39
95	285	149.00	364	35.56	6.97

As indicated in the above table, maintaining the SFP temperature limit of 150 °F is based on two parameters. The first is the CCWS water temperature. The second is the SFAs in-reactor vessel decay time following reactor shutdown. Therefore, the licensee established the constraints as shown in the proposed FSAR Figure 9.1-20, "Fuel Assembly Transfer Limit Versus CCP (CCW) Temperature," for fuel discharge operation. The licensee stated that the proposed FSAR Figure 9.1-20 will become part of the MNPS-3 licensing and design bases and thus would be subject to change control under 10 CFR 50.59. In addition, plant procedure RE 31007, "Refueling Operations," will be revised to reflect the constraints shown in the proposed FSAR Figure 9.1-20 for the control of SFA discharge limit.

Also, the licensee evaluated the consequences of a single active failure of the operating SFPCS train during planned refueling outages. The licensee stated that the action having the greatest impact on the availability of SFP cooling trains is the maintenance outage of an electrical bus. In this case, the loss of the SFP pump of the operating train is the only active failure that does not have a backup during maintenance on an electrical bus. Therefore, the licensee assumed failure of the operating SFPCS train pump at a pool temperature of 150 °F and a total loss of SFP cooling for 30 minutes.[6] Results of the evaluation indicate that the SFP water temperature would rise to 155.7 °F for a short duration. The licensee performed an evaluation and verified that the SFP systems, structures and components are all designed for normal operation at the environmental and service conditions that would result from a steady-state SFP temperature of 155.7 °F.

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4 The time after reactor shutdown at which the SFP water reaches its calculated peak temperature.

5 While the Holtec analysis shows that at the CCW temperature of 80 °F, fuel movement could start as soon as 101 hours, the limitation shown in FSAR Figure 9.1-20 does not permit movement until 132 hours, which was established for the existing Westinghouse storage racks.

6 The 30 minutes represents the time necessary to place the SFPCS pump of the standby cooling train into service.

Based on the transient nature of the SFP temperature for a short duration, the continuously decreasing decay heat load of the SFP inventory, the conservative assumptions used in the decay heat calculation, and the heat transfer that exists through the concrete,[7] the staff finds that duration of the 155.7 °F temperature is well within the licensing basis limit of 24 hours[8] and, therefore, is acceptable.

Subsequently, the licensee stated that, following the commencement of core offload activities, should it be necessary to remove a train of the SFPCS from service due to planned maintenance on its associated support equipment, they are taking the following appropriate contingency actions to ensure the restoration for SFP cooling:

1. A pre-fabricated temporary cable will be used to supply power to the SFPCS pump of the standby cooling train upon an active failure of the pump of the operating SFPCS train.

2. Operating procedures will be established to require that the necessary equipment is available to respond to SFPCS single failures (service water system, CCWS pump, and SFPCS pump) prior to the SFP water temperature exceeding 155.7 °F.

3. Operating procedures are being revised to explicitly deal with loss of SFP cooling and restoration of cooling function prior to exceeding 155.7 °F.

4. The setpoint and the alarm response procedure for high SFP temperature is being revised. The current setpoint of 135 °F is being lowered to 125 °F to match the entry condition of the emergency operating procedure (EOP) for loss of SFP cooling. This will allow more than 2 hours for operator investigation and temporary cable installation prior to exceeding the temperature of 155.7 °F.

Based on the licensee's evaluation, its decision to impose in-vessel decay time for SFA discharges at various CCWS water temperatures, and its decision to establish procedures and corrective actions to place the SFPCS pump of the standby cooling train into service should a single active failure occur, the staff finds that the design and operation of the SFPCS meet the intent of the guidance described in the Standard Review Plan (SRP) Section 9.1.3, "Spent Fuel Pool Cooling and Cleanup System" for SFPs. Therefore, the staff concludes that the design and operation of the SFP cooling system to support full core offload as a normal evolution at MNPS-3 are acceptable.

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[7] No credit is taken for the heat transfer through the concrete in the SFP thermal-hydraulic analysis.

[8] The current licensing basis (as described in FSAR Sub-section 9.1.3.1, "Design Bases," criterion 14, of Section 9.1.3, "Fuel Pool Cooling and Purification System") allows for short term (i.e. on the order of 24 hours) SFP temperature excursions above 150 ^{0}F to 200 ^{0}F.

3.2 Effects of a Complete Loss of Cooling to the SFP

3.2.1 Loss of SFP Cooling Following a Design Basis Accident

As indicated in Section 3.1of this SE, the SFPCS was, in part, designed to maintain the SFP water temperature at or below 200 °F following a design basis accident (DBA) with a LOOP resulting in a loss of SFP cooling for 4 hours. The licensee evaluated the effects of the proposed increase of SFP storage capacity on the capability of the SFP to cope with the 4-hour loss of cooling following a DBA. The licensee stated that, at the end of the 4 hours of loss of cooling following a DBA, the SFP water temperature would rise from 127.6 °F at the start of the event to 148.8 °F, which is below the licensing basis temperature of 200 °F.[9]

Based on our review of the licensee's evaluation, the staff concludes that the proposed change to the licensing basis to allow an entire core to be offloaded into the SFP as a routine refueling practice and to allow an increase of the SFP storage capacity from 756 to 1860 SFAs will not have a significant impact on the SFP cooling following a DBA with a LOOP and is, therefore, acceptable .

3.2.2 Complete Loss of Cooling to the SFP during Planned Refueling Outage

In the unlikely event that there is a complete loss of SFP cooling without any recovery actions, the SFP water temperature will begin to rise and eventually will reach the boiling temperature. Taking the proposed increase of SFP storage into account and based on the most severe scenario, the minimum time from the loss of pool cooling at peak SFP water temperature until the pool boils is 5.47 hours with a maximum boil-off rate of 95 gpm. Makeup water for the SFP is provided from the primary makeup system by two redundant pumps (225 gpm each).

Based on the licensee's evaluation of the impact of a complete loss of cooling on the SFP and the available make-up water for SFP boiling, the staff finds that, in the unlikely event of a complete loss of SFP cooling, the licensee has sufficient time to align make-up water to the SFP before boiling begins and that make-up water can be supplied at a rate that exceeds the boil off rate. Cooling the SFP at MNPS-3 by adding makeup water during the unlikely event of a complete loss of SFP cooling conforms with the guidance described in the SRP Section 9.1.3. Therefore, it is acceptable.

3.3 Fuel Handling Area Ventilation

The fuel handling building ventilation system (FHBVS) is designed to remove heat generated by equipment and water vapor from SFP evaporation, prevent moisture condensation on interior walls, and provide a suitable environment for equipment operation and personnel. It also limits the potential radioactive release to the atmosphere following a postulated fuel handling accident.

The licensee performed an analysis to evaluate the impact of the higher SFP water temperature resulting from a full-core offload and the increase of SFA storage capacity in the SFP on the

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[9] Based on the calculated bounding heat load of 21.1×10^6 BTU/hr for the SFP during the last operating cycle with one SFP cooling train in operation.

fuel handling area ventilation system. The licensee stated that a calculated bounding ambient air temperature of 108 °F falls within the range (-55 °F to 120 °F) specified for the filter assemblies' normal environment. The calculated evaporation rate of 5.1 gpm at a SFP water temperature of 150 °F is well within the total moisture separation capacity of the 21 separators. The licensee stated that no changes were made to the FHBVS and the associated operating equipment. Based on the staff's review, the proposed change to the SFP temperature limit is bounded by the current FHBVS design bases, as stated in the FSAR Section 9.4.2. Based on our review of the licensee's evaluation, the staff concludes that the proposed full-core offload during planned outages and the increase of SFA storage capacity in the SFP will have an insignificant or no impact on the fuel handling area ventilation system.

As noted above, the increased SFP temperature results in an increase in the overall evaporation rate from the SFP. An increased evaporation rate could result in a small increase in the amount of gaseous tritium released from the SFP. The annual release of radioactive material to the atmosphere from MNPS-3 has historically been well below the value of Appendix I to 10 CFR Part 50. Any expected increase in the amount of tritium released from the SFP as a result of the storage of additional spent fuel will have little effect on the overall quantity of radioactive material released to the atmosphere from the plant. It is expected that the annual airborne effluent releases from MNPS-3 will continue to satisfy the requirements of 10 CFR 20.1302, 40 CFR 190, and Appendix I to 10 CFR 50 and, therefore, are acceptable.

In summary, based on our review of the licensee's justification, analyses, and actions to incorporate the above cited constraints for all SFA discharge scenarios in MNPS-3's operating procedures, and the licensee's actions to update the FSAR to reflect the above information regarding the SFP cooling, the staff concludes that the licensee's proposal to allow an entire reactor core to be offloaded to the SFP as a routine, planned evolution is acceptable. Furthermore, the staff concludes that the approved increase to the SFP cooling limit will still allow adequate cooling of the SFP even with the increased SFP capacity as proposed in the licensee's March 19, 1999, SFP amendment request, which is under separate review.

3.4 Effects of SFP Temperature Increase on Gaseous Tritium Release

As noted above, the increased SFP temperature results in an increase in the overall evaporation rate from the SFP as a result of the increased heat loading in the SFP from the proposed increase in the peak bulk SFP temperature from 140 °F to 150 °F. An increased evaporation rate would result in a small increase in the amount of gaseous tritium released from the SFP. In the licensee's response, dated August 10, 2000, to a staff request for additional information, the licensee performed a calculation to determine the maximum estimated annual release of tritium from the SFP. The licensee's calculation used several conservative assumptions to obtain a worst case estimate for tritium release. On the basis of the licensee's calculations, the maximum release of tritium would occur at the end of plant life (18 cycles beyond the most recent refueling conducted at MNPS-3). The licensee estimated that the resulting bounding estimate for tritium release from the SFP would result in a dose to the public that would be below the values of Appendix I to 10 CFR Part 50.

The annual release of all radioactive material to the atmosphere from MNPS-3 has historically been well below the values of Appendix I to 10 CFR Part 50. Tritium typically comprises a small percentage of the total radioactive material released to the atmosphere. The tritium release from MNPS-3 is an input to the plant design basis for radiological effluent controls as defined by the requirements contained in 10 CFR Part 20, 10 CFR Part 50 Appendix I, and the plant TSs. The licensee maintains a monitoring program for radiological effluents which includes ongoing evaluations of changes in patterns of radioactive releases in order to assess the need to make changes to the program. If the magnitude of the release of tritium from the SFP should become significant, the licensee would initiate changes to ensure that releases to the environment would remain within appropriate regulatory and TS limits. It is expected that the annual airborne effluent releases from MNPS-3 will continue to satisfy the requirements of 10 CFR 20.1302, 40 CFR Part 190, and Appendix I to 10 CFR Part 50. On this basis, the staff finds the licensee's plan to increase the peak bulk SFP temperature by 10 °F to be acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Connecticut State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves 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 the amendment involves no significant hazards consideration, and there has been no public comment on such finding (64 FR 11962). Accordingly, the amendment meets 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 or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission 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, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributors: D. Shum
C. Hinson

Date: September 12, 2000