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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 161

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 April 14, 1998, as supplemented May 7, 1998, and two letters dated June 4, 1998, Northeast Nuclear Energy Company, et al. (the licensee), submitted a request for changes to the Millstone Nuclear Power Station, Unit No. 3 Technical Specifications (TS). The requested change would amend TS 3/4.4.4, Relief Valves, to ensure that the power-operated relief valves (PORVs) will be capable of automatic cycling as well as manual cycling when in the TS 3/4.4.4 action statements that allow indefinite continued operation while a PORV with excessive seat leakage is isolated. The proposed amendment would also make editorial changes, add PORV surveillance requirements, and modify the associated Bases section. The proposed changes provide added assurance that the pressurizer safety relief valves will not be damaged due to water relief during an inadvertent safety injection (ISI) event. The May 7, 1998, letter and the two letters dated June 4, 1998, provide clarifying information that did not change the scope of the April 14, 1998, application and the initial proposed no significant hazards consideration determination.

2.0 BACKGROUND

The Millstone Unit 3 pressurizer is configured with two PORVs, each with their own individual block valve, and three safety valves. The PORVs are solenoid-operated valves, which are powered from the Class 1E power system and can be operated automatically or by remote manual control. The safety valves are mechanical and are of the pop-type and do not have isolation valves.

The licensee is proposing to change TS 3/4.4.4, Relief Valves, to address a previously identified question regarding the plant operators' ability to meet the operator response time of 10 minutes assumed in Chapter 15 of the Final Safety Analysis Report (FSAR) evaluation of an ISI event. Specifically, a configuration management program review questioned the operator response time assumed in the ISI analysis. Specifically, in the ISI event, the analysis assumed that the operator terminates the injection flow to avoid an overfill of the system (i.e., solid pressurizer) in 10 minutes. However, simulator experience indicated that the operators' response to prevent pressurizer overfill was not acceptable. Water relief from the pressurizer safety valves could lead to valve failure and a resultant unisolable reactor coolant system leak. The licensee formally notified the NRC of this issue on December 31, 1997, in Licensee Event Report 97-063-00.

To address this issue, the licensee is proposing to qualify the PORVs and associated piping for water relief and is taking credit for automatic PORV operation. Therefore, the licensee is changing TS 3/4.4.4 to allow indefinite operation only if the PORV is inoperable due to excessive seat leakage. In addition, an emergency operating procedure (EOP) change is being made to ensure that the PORV block valves are open within 10 minutes and 45 seconds from event initiation. This will ensure that the PORVs remain available for pressure relief as required to justify the new accident analysis assumptions. The licensee's proposed change is similar to one the NRC approved for the Salem Nuclear Generating Station, Unit Nos. 1 and 2, in a June 4, 1997, license amendment.

3.0 EVALUATION

To provide added assurance that the pressurizer safety relief valves will not be damaged due to water relief during an ISI event, the licensee upgraded the PORV circuitry, added additional PORV surveillance requirements, qualified the PORVs and associated piping for water relief, and made EOP changes to allow plant operators additional time to terminate the event. The NRC has reviewed these changes and the staff's conclusions are documented herein.

3.1 Upgrade of PORV Circuitry

The existing electrical and control system associated with the automatic operation of the PORVs is designed to control grade standard without protection from single failures. In order to take credit for the PORVs automatic function for mitigating the ISI actuation event, the licensee, in a letter dated April 14, 1998, proposed modification to the PORV circuitry to eliminate single failure vulnerabilities in the PORV circuitry and upgrade circuitry to qualify the PORVs as safety-related.

The current PORV opening logic actuates on a 1/1 logic. A selectable control is provided so that either one of two channels can be selected to control each PORV opening. One PORV is programmed to open at a set pressure of 2350 pounds per square inch absolute (psia). The other PORV is part of the pressurizer pressure control logic that controls pressurizer spray, heaters, and the one PORV. This PORV would open 100 psi above the controller pressure setting. The current PORV closing logic is safety-grade based upon a 2/4 pressurizer pressure low logic.

In its April 14, 1998, letter, the licensee states that the safety-grade closing logic will be used for the safety-grade open logic. A 2/4 logic will be used to open the PORVs based on pressurizer pressure greater than 2350 psia. The PORV closure logic will be 3/4 that actuates when pressurizer pressure drops 20 psi below the opening setpoint. Since the stroke time for the PORV is very short (approximately 1 second), the closing pressure is adequate to assure that the valve will cycle as designed. The PORV open circuitry is designed to require energization to open, thus, minimizing the potential for spurious opening of the PORVs. The licensee stated that the PORV control circuitry was upgraded to eliminate single failure vulnerabilities and qualify the PORV controls as safety-related. The licensee further stated that they utilized the guidance in IEEE Standard 279 in the design of the PORV control circuitry.

The NRC staff concludes that the above changes to the PORV circuitry will eliminate single failure vulnerabilities and qualifies the PORV control circuitry as safety-related. Therefore, the NRC staff finds the changes acceptable.

3.2 Addition of PORV Surveillance Requirements

TS 4.4.4.1 currently requires that each PORV be operable at least once each refueling interval by (1) performance of a channel calibration, and (2) operating the valve through one complete cycle of full travel during Modes 3 and 4. In its April 14, 1998, letter, the licensee proposed adding two additional surveillance requirements to Surveillance Requirement 4.4.4.1. Specifically, the licensee proposed adding (1) the performance of an analog channel operational test on the PORV high pressurizer pressure actuation channels (excluding valve operation), at least once each quarter, and (2) verification that the PORV high pressure automatic opening function is enabled at least once per 12 hours. The licensee stated that the changes to the surveillance requirements add the appropriate requirements to provide assurance that the automatic capability of the PORVs is operable. If the automatic capability of one PORV is inoperable for more than 72 hours, TS 3.4.4.b requires the plant to be in hot standby within the next 6 hours and in hot shutdown within the following 6 hours. If the automatic capability of both PORVs are in inoperable for more than 1 hour, TS 3.4.4.c requires the plant to be in hot standby within the next 6 hours and in hot shutdown within the following 6 hours. The NRC staff has reviewed the additional surveillance requirements and the actions the licensee must take if one, or both, PORV is inoperable due to causes other than excessive seat leakage. Since the surveillance requirements provide assurance that the automatic capability of the PORVs is operable, the staff finds them acceptable.

3.3 PORV Performance

In its letter dated April 14, 1998, the licensee stated that the current ISI analysis assumed that the operator terminates the injection flow to avoid an overfill of the system (i.e., solid pressurizer). However, the licensee stated that operator experience at the simulator may not support this assumption in all cases. Therefore, the licensee decided to qualify the PORVs and associated piping for water relief in order to provide more time for operator action.

In order to demonstrate that the PORVs were qualified for water relief for approximately 1 hour, the licensee reanalyzed the event with LOFTRAN to extend the analysis time frame (the Westinghouse LOFTRAN computer code (WCAP-7907-P-A, 1984) has been approved by the NRC for transient analysis, both generically and specifically for Millstone Unit 3). The LOFTRAN results were used for the following purposes: (1) determine the maximum time allowable for operator action to assure that at least one PORV would be available to mitigate the transient; (2) provide the mass and energy releases needed to qualify PORV piping and associated piping supports for water relief; and (3) provide the mass and energy releases needed to qualify the PORVs for water relief.

The Millstone Unit 3 PORVs are pilot-operated, cage-guided globe valves designed and manufactured by Garrett Pneumatic Systems Division of Garrett Corporation. The Electric Power Research Institute (EPRI) test report (EPRI report NP-2670-LD Volume 11), which was performed to generically resolve post Three Mile Inland, Unit 2 issues associated with PORVs and safety valve qualification for water and steam relief, documents results from four tests of the Garrett PORV for water relief. The EPRI test results were used to calibrate standard valve sizing methodologies while taking into account the specific test valve parameters and conditions. The calibrated models were used to predict the mass and energy releases of the Millstone Unit 3 PORVs. The predicted results compared favorably with the mass and energy releases from LOFTRAN. From evaluation of the EPRI test conditions and results, the licensee concluded that the test conditions bound the conditions associated with an inadvertent ECCS actuation at power

transient. Mass and energy releases of the Millstone Unit 3 PORVs predicted by LOFTRAN compare favorably with predictions from models that were calibrated with the EPRI test data results.

In its April 14, 1998, letter, the licensee stated that the PORVs and associated piping are qualified for 1 hour of water relief for an inadvertent ECCS actuation at power operation. The licensee stated that 1 hour provides sufficient margin for the operator to terminate the event.

In the June 4, 1998, letter, the licensee stated that the plant PORVs will function properly for the 338 cycles estimated for the ISI event. The licensee also stated that the PORV manufacturer performed numerous cycle tests to verify the performance of the valve design which consisted of: [illegible] cycles to verify the performance of the valve packing, 75 cycles using air at pressures ranging from 250 to 2500 psig, and 50 cycles using water with inlet pressure of 2385 psig. The test valve functioned as required during these tests. Following this testing, the PORV manufacturer tested the valve seat leakage and it was found to be acceptable. In addition, during hot functional testing at another nuclear plant site which utilizes the same model valves, the PORVs were cycled over 100 times. During these tests, the valves were examined numerous times and the valve internals were not damaged. In the May 7, 1998, letter, the licensee also stated that the PORV solenoids are designed for continuous duty.

Although the test conditions regarding fluid, temperature, and pressure for the manufacturer's tests are not representative of the conditions expected for the ISI event, the hot functional tests performed at another plant are representative of the expected valve fluid conditions. Therefore, the staff finds that the manufacturer's tests and the hot functional tests, taken together with the tests performed by EPRI, provide adequate assurance that the plant PORVs will perform adequately for the estimated 338 cycles required for the ISI event.

In the May 7, 1998, letter, the licensee stated that the PORV block valves are motor-operated valves which have also been evaluated for water relief in accordance with the Generic Letter (GL) 89-10 program.

The NRC staff has reviewed the licensee's submittals regarding the qualification of the PORVs for water relief during the ISI event. Since the testing provides adequate assurance that the plant PORVs will perform adequately during an ISI event, the staff finds them acceptable.

3.4 PORV Piping and Support Performance

The mass and energy releases provided by LOFTRAN were used as an input to the qualification of the PORV piping and piping supports for water relief. The analysis performed for the ISI event utilized the same techniques as the cold overpressure protection system analysis, except that the RELAP5 program was utilized in lieu of the WATHAM program to determine the forcing functions, which are input into the piping program to determine pipe stress and support loads. The licensee stated that RELAP5 was chosen over WATHAM since it more accurately models the two-phase flow characteristics for the ISI event. The licensee further stated that RELAP5 has been utilized previously on Millstone Unit 3 and has been approved for use by the NRC. The PORV characteristics were modeled in RELAP5 to match the most limiting mass flowrates provided in the LOFTRAN results. Additionally, the licensee stated that the full mass flowrate calculated by LOFTRAN for one PORV was applied simultaneously to both PORVs in order to bound pipe stress and support loading. The licensee concluded that the piping and support analysis demonstrate that the current piping and support configuration are adequate to withstand the loads associated with the water relief.

The NRC staff has reviewed the licensee's submittal regarding the evaluation of the PORV piping and supports for water relief during the ISI event. Since the analysis demonstrates that the current piping and support configuration are adequate to withstand the loads associated with the water relief, the staff finds it acceptable.

3.5 Operator Performance

The original design of the licensee's safety systems and the systems' ability to respond to design-basis accidents are described in the licensee's FSAR. Automatic action is frequently provided as a design feature specific to each safety system to ensure that the specific functions of the system will be accomplished. In a few cases limited operator actions, when appropriately justified, were approved. Proposed changes that substitute manual operator actions for automatic system actuation or modify existing operator actions, including operator response times, previously reviewed and approved during the original licensing review, must be evaluated under the criteria of 10 CFR 50.59. In those instances where licensees consider temporary or permanent changes to the facility that credit operator actions, the NRC has relied on the guidance provided in GL 91-18, "Resolution of Degraded and Nonconforming Conditions and on Operability," dated November 7, 1991, and ANSI/ANS 58.8, "Time Response Design Criteria for Safety Related Operator Actions," 1984 (ANSI-58.8), for evaluating such changes. The licensee's proposed change to the Millstone Unit 3 TS credits operator actions to open PORV block valves in step 16 of EOP 35, Revision 19, E-0, "Reactor Trip or Safety Injection."

The staff used the guidance in GL 91-18 and ANSI-58.8 relevant to manual operator actions and times to perform those actions to complete its evaluation of the licensee's submittals. GL 91-18 states that in a "...situation in which substitution of manual action for automatic action may be acceptable, the licensee's determination of operability must focus on the physical differences between automatic and manual action and the ability of the manual action to accomplish the specified function. The physical differences to be considered include, but are not limited to, the ability to recognize input signals for action, ready access to or recognition of setpoints, design nuances that may complicate subsequent manual operation such as auto-reset, repositioning on temperature or pressure, timing required for automatic action, etc., minimum manning requirements, and emergency operating procedures written for the automatic mode of operation. The licensee should have written procedures in place and training accomplished on those procedures before substitution of any manual action for the loss of an automatic action." ANSI-58.8 provides estimates of reasonable response times for operator actions, and allows licensees to use time intervals derived from independent sources, provided they are based on analyses with consideration given to human performance. The staff evaluated the task-analysis-related information provided by licensees with regard to the following considerations: specific operator actions and the times to perform those actions, environmental conditions expected, procedural guidance for the required actions, support personnel and/or equipment required to carry out the required actions, specific operator training necessary to carry out the required actions, information requirements including qualified instrumentation, recovery from plausible errors, and risk significance of the proposed operator actions.

The licensee stated that the ISI event requires an operator to check reactor coolant system pressure and to check open or open at least one of the two PORV block valves within 10 minutes and 45 seconds of the initiation of an ISI event. These actions ensure a relief path via a PORV and precludes the potential for early steam or water relief through a pressurizer safety valve. Adequate time, approximately 1 hour, is then available for termination of the ISI event prior to

challenging the pressurizer safety valves. The licensee provided simulator data indicating that operators demonstrated the ability to perform the necessary actions in a timely manner. Under conservative conditions, the time from event initiation until operating crews completed these required actions ranged from 4 minutes and 34 seconds to 8 minutes with an average time of 6 minutes and 41 seconds. The operator actions are performed in the control room and are subject to predetermined, tolerable environmental conditions during this event. Adequate procedural guidance is provided in EOP 35, Revision 19, E-0, step 16. No additional support personnel or support equipment is required. Operators have received or are scheduled to receive detailed knowledge-based and skill-based training on this specific change through crew briefing, simulator training, and continuous training. The control board operation of the PORV block valves is performed by the manipulation of a commonly used three-position switch with open and shut valve position light indications just above the switch. The PORV block valves, PORVs, indications, and controls are appropriately qualified. The licensee demonstrated through simulation that adequate time is available to recover from plausible human performance errors such as manipulation of the wrong PORV block valve, and consideration was given to the risk significance of the proposed operator actions.

The staff has reviewed the licensee proposed changes to TS 3/4.4.4 and its Bases section concerning the use of PORVs for mitigation of an ISI event in regard to the aspects related to human performance. The staff finds that the licensee's proposed TS and the associated required operator actions are consistent with GL 91-18 and ANSI-58.8 and, therefore, are acceptable.

3.6 Summary

The licensee's proposed TS regarding PORVs would assure the operability of the PORVs for their automatic and manual operating function. Also, the proposed TS are consistent with the recommendation of GL 90-06, "Resolution of Generic Issue 70, 'Power-Operated Relief Valve and Block Valve Reliability,' and Generic Issue 94, 'Additional Low-Temperature Overpressure Protection for Light-Water Reactors'," dated June 25, 1990, and, therefore, acceptable. The proposed TS Bases provide clarifications of the safety-related function to be performed by the PORVs including the use of the automatic function of the PORVs to mitigate an ISI event. The staff reviewed the licensee's submittals, including the editorial changes, and finds the proposed changes 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 and changes surveillance requirements. 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 (63 FR 19532 dated April 20, 1998). 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.

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Date: June 5, 1998