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Docket No. 50-336
B15653

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Millstone Nuclear Power Station, Unit No. 2
Response to Staff's Request Regarding
Reactor Coolant System Heatup and Cooldown Weaknesses
NRC Combined Inspection 50-245/95-44;
50-336/95-44; 50-423/95-44

In a letter dated March 6, 1996,[1] the NRC Staff transmitted NRC Inspection Report Nos. 50-245/95-44; 50-336/95-44; and 50-423/95-44. The report discussed the results of the safety inspection conducted on December 27, 1995, through February 7, 1996, at the Millstone Station. Based on the results of the Staff's inspection, two of Millstone Unit No. 1's activities were determined to be in violation of NRC requirements. The response to these violations is sent separately to the Staff under Unit No. 1's docket.[2]

In addition to the cited violations, significant weaknesses were identified at Millstone Unit No. 2 which contributed to several recent failures to maintain plant parameters within required safety specifications. Specifically, controls for maintaining reactor coolant system temperatures within required limits during plant heatup and cooldown were not adhered to. Consequently, the Staff requested that NNECO provide detailed assessment of the causal factors underlying these failures and a complete

(1) W. D. Lanning letter to T. C. Feigenbaum, "NRC Combined Inspection 50-245/95-44; 50-336/95-44; 50-423/95-44 and Notice of Violation," dated March 6, 1996.

(2) F. D. Dacimo letter to U. S. Nuclear Regulatory Commission, "Millstone Nuclear Power Station, Unit No. 1, Reply to a Notice of Violation, NRC Combined Inspection 50-245/95-44; 50-336/95-44; 50-423/95-44," dated April 11, 1996.

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description and schedule of corrective actions. In a subsequent discussion with the Staff, NNECO committed to provide the requested information in two submittals as the Event Review Teams (ERTs) complete their reviews of the heatup and cooldown events. NNECO will supplement this response with the additional information requested when the coodown ERT completes its efforts and unit management schedules the corrective actions. Accordingly, Attachment 1 to this letter provides NNECO's reply, on behalf of Millstone Unit No. 2, pursuant to the Staff's request. The supplemental response is scheduled to be provided by May 30, 1996.

The following are NNECO's commitments within this letter. All other statements are for information only.

B15653-1 NNECO hereby commits to provide the Staff with a supplemental response that contains an executive summary of the cooldown ERT findings and recommendations by May 30, 1996.

B15653-2 NNECO hereby commits to develop revisions to the heatup, cooldown, shutdown cooling system and heatup/cooldown monitoring procedures by use of a multi-discipline team to assist operations personnel in developing the appropriate definitions of what needs to be monitored, the best strategy for system operation and the procedure revisions.

B15653-3 NNECO hereby commits to utilize the new procedures during simulated heatup and cooldown evolutions.

B15653-4 NNECO hereby commits to develop in an integrated fashion that will include Operations, Technical Support, Training and Chemistry, a method to control noncondensable gases in the reactor coolant system during outages for all shutdown conditions.

B15653-5 NNECO hereby commits to revise the operating procedures to include appropriate caution steps to assist the operator in recognition and handling of the noncondensable gases.

B15653-6 NNECO hereby commits to evaluate the existing plant systems to see if they are adequate for the handling of noncondensable gases during rapid shutdowns.

B15653-7 NNECO hereby commits to forward a copy of the completed schedule for corrective actions to the Resident Inspector for both the heatup and cooldown ERT recommendations.

B15653-8 NNECO hereby commits to include in our supplemental response, information to address the concern of lack of conservative operating guidance and provide a discussion on the resolution of operator burdens.

If you have any questions regarding information contained herein, please contact Mr. G. P. van Noordennen at (860) 440-2084.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

F. R. Dacimo
Vice President - Nuclear Operations

cc: T. T. Martin, Region I Administrator
J. W. Andersen, NRC Project Manager, Millstone Unit No. 1
J. T. Shedlosky, Acting Senior Resident Inspector, Millstone Unit No. 1
G. S. Vissing, NRC Project Manager, Millstone Unit No. 2
P. D. Swetland, Senior Resident Inspector, Millstone Unit No. 2

Docket No. 50-245
B15653

Attachment 1

Millstone Nuclear Power Station, Unit No. 2

Response to Staff's Request Regarding
Reactor Coolant System Heatup and Cooldown Weaknesses
NRC Combined Inspection 50-245/95-44;
50-336/95-44; 50-423/95-44

April 1996

Millstone Nuclear Power Station, Unit No. 2
Response to Staff's Request Regarding
Reactor Coolant System Heatup and Cooldown Weaknesses
NRC Combined Inspection 50-245/95-44;
50-336/95-44; 50-423/95-44

On December 17, 1995, Millstone Unit No. 2 completed preparations for and commenced a plant heatup from Mode 5. During the heatup, both the reactor coolant system (RCS) heatup rate limit (50°F/hr) and pressurizer heatup rate limit (100°F/hr) were exceeded. On February 22, 1996, during the Millstone Unit No. 2 cooldown to Mode 5, the cooldown rate was exceeded.

In response to these events, Heatup and Cooldown Event Review Teams (ERTs) were created to investigate the events and determine causes and corrective actions. However, the ERTs' reports had not been completed upon issuance of the Staff's inspection report dated March 6, 1996. Accordingly, the Staff requested that NNECO provide a detailed assessment of the causal factors underlying these events, as well as a complete description and schedule for the corrective actions.

At the time of this letter's preparation, the Heatup ERT report had been complete and a copy provided to the NRC Resident Inspector. The Cooldown ERT Report has not been completed as of the time of this letter's preparation. Accordingly, an executive summary of the Cooldown ERT findings and recommendations is not provided in this response. A supplemental response providing this information is scheduled for submittal by May 30, 1996.

Heatup ERT Executive Summary

The reactor coolant system excessive heatup rate (72°F/hr) was primarily due to inappropriate computer software. From the time shutdown cooling was secured until establishing heatup control using the atmospheric dump valves, there was no computer indication of a violation of the heatup rate limit. The software inadequacies included the monitoring of computer inputs that were not representative of the reactor vessel downcomer region and time-averaged mathematical functions that both delayed and smoothed the data.

The pressurizer excessive heatup rate was primarily due to the presence of noncondensable gases in the pressurizer steam space. As the reactor coolant system pressure was raised in preparation for starting the reactor coolant pumps, the operating shift identified and discussed the difference between steam and water phase temperatures in the pressurizer, but failed to understand that a blanket of noncondensable gases was insulating the top of the pressurizer and the steam space temperature indicator. After starting two reactor coolant pumps, the operating shift chose to

control pressure with forced spray, which mixed the gas and steam resulting in steam contacting the temperature element and raising the steam space temperature at a rate which exceeded the pressurizer heatup rate limit.

Causal Factors and Corrective Actions

The causal factors and corrective actions have been grouped into four areas which include design documents and procedures, control of noncondensable gases, response to a previous event and plant design shortcomings.

Design Documents and Procedures

Causal Factors

A significant causal factor for the reactor coolant system heatup event is that the design documents do not provide sufficient detail concerning what constitutes a heatup/cooldown or which instrumentation should be utilized for calculating the heatup/cooldown rates in the reactor coolant system or pressurizer for the different phases of the heatup, i.e., shutdown cooling, natural circulation and forced circulation phases. This lack of detail led to less-than-adequate procedures and monitoring capabilities to control heatup/cooldown evolutions. As an example, the lack of sufficient detail led to the utilization of temperature indicators that were not representative of the vessel downcomer region, which is the limiting area of the vessel, for heatup and cooldown transients. The lack of understanding of the requirements also led to the development of a software package that did not monitor the actual temperatures of interest and did not utilize appropriate mathematical techniques.

Corrective Actions

The immediate corrective actions have focused on developing major revisions to the heatup, cooldown, shutdown cooling system and heatup/cooldown monitoring procedures. Revising the procedures required a multi-discipline team to assist operations personnel in developing the appropriate definitions of what needs to be monitored, the best strategy for system operation and the procedure revisions.

Other short term corrective actions included shutting off the software applications that had contributed to the monitoring problem and replacing this software with a graphics package that provides a visual trend. The procedures for control of heatups, cooldowns, shutdown cooling system operation and heatup/cooldown monitoring are undergoing extensive revision, validation and operator training on the simulator. These procedures incorporate the previously missing definitions and additional steps to eliminate much of the ambiguity that previously existed. The new

procedures incorporate additional steps for placing the systems in service or removing them from service that reduces or eliminates the system thermal transients. Training will include use of the new procedures during simulator heatup and cooldown evolutions.

Control of Noncondensable Gases

Causal Factors

The pressurizer heatup event was caused by an accumulation of noncondensable gases blanketing the steam space temperature detector and the subsequent utilization of pressurizer spray which mixed the steam space volume and triggered the temperature transient at the top of the pressurizer. Although requirements are established for noncondensable gas concentrations when entering a shutdown where the primary system boundary is being breached, neither operations or chemistry personnel recognized the need to manage the noncondensable gas inventory during short shutdowns when the primary system boundary is not being breached.

In addition, Chemistry personnel did not have adequate baseline data on noncondensables present in the pressurizer steam space during shutdowns. Plant procedures did not provide guidance for evaluation of or the actions to be taken when differences between the pressurizer steam space and water space temperatures were observed. Appropriate actions would include the venting of the pressurizer or other compensatory measures that would assure the noncondensable gases were removed from the reactor coolant system during changes in reactor coolant pressure.

Corrective Actions

The corrective actions for the control of noncondensable gases in the reactor coolant system during outages will be addressed for all shutdown conditions. This is being approached in an integrated fashion that will include Operations, Technical Support, Training and Chemistry. The operating procedures are being revised to include appropriate caution steps to assist the operator in recognition and handling of the gases. Chemistry has issued an action plan to develop an overall strategy for the management of noncondensable gases which will include owners' group activities, the development of data bases and providing feedback for future changes to procedures and training. Technical Support has been tasked with evaluating the existing plant systems to see if they are adequate for the handling of noncondensable gases during rapid shutdowns.

Responses to a Previous Event

Causal Factors

During the summer of 1995, a heatup event similar to the December event occurred and an evaluation identified inadequate training and lack of detail in the procedure as primary root causes for the event. The corrective actions taken on these issues have not been effective as seen by the continued lack of sensitivity to the system conditions during the startup in December of 1995. The corrective action assignments made as a result of the previous investigation were not prioritized in an appropriate fashion in that they were too far in the future and the responsible individuals were not sensitive to the importance of the issues. Although the opportunity existed and the subjects were identified, the weak operating practices and lack of training for startup evolutions were not given sufficient emphasis by unit management. Although the incorrect software existed at the time of the July 1995 investigation, there were no clues in the data that would have led the investigation team to question this area.

Corrective Action

Corrective actions implemented to increase the effectiveness of the ERTs' recommendations include the development of a series of explicit recommendations, with specific assignments at the manager level. Additional management attention will be placed on the timely completion of ERT recommendations. This approach should prevent recurrence of the previous problems that resulted in the efforts not being effective.

Plant Design

Causal Factor

An additional causal factor that was identified during the December 1995 event investigations is that weaknesses in the plant design exacerbated the situation and placed additional demands on the operator. The reactor coolant pump minimum seal pressure requirements combined with the upper design pressure limits of the shutdown cooling system do not allow the start of the reactor coolant pumps while the shutdown cooling system is in service. These limitations require the operator to secure the shutdown cooling system and to raise reactor pressure prior to the start of the first reactor coolant pump. This forces the operator into a one hour Technical Specification action statement and causes significant thermal-hydraulic changes in the region of the reactor vessel downcomer. A similar sequence of events exists during plant cooldowns.

Corrective Actions

Corrective actions in this area include ongoing evaluations to define the conditions which would allow the operation of the reactor coolant pumps in parallel with the shutdown cooling system. These modes of operation have not been available to the operator in the past and would greatly simplify the task of managing the reactor coolant system during this transition period.

Schedule for Heatup Event Corrective Actions

A detailed schedule of corrective actions for the heatup event is currently being developed. Upon completion, a copy of the schedule will be forwarded to the Resident Inspector. The corrective actions are being scheduled into three groups. The first group will be `immediate' actions determined to be necessary prior to entering Mode 4. The second group will be `short term' corrective actions determined to be necessary prior to entering Mode 3. The final group will be `long term' items such as monitoring owners' group activities in this area.

Additional Information

In addition to the information provided above, the Staff requested that NNECO address the concern of lack of conservative operating guidance and provide a discussion on the resolution of operator burdens. Since these information are still under development, these responses will be included with the supplemental response.