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August 4, 1993

Docket Nos. 50-423
B14567

Re: Generic Letter 93-04

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

Millstone Nuclear Power Station Unit No. 3
Response to Generic Letter 93-04

Pursuant to the provisions of 10 CFR 50.54 (f), the NRC Staff issued Generic Letter 93-04, "Rod Control System Failure and Withdrawal of Rod Control Cluster Assemblies,"[1] on June 21, 1993, and addressed it to all licensees with the Westinghouse Rod Control System (except the Haddam Neck Plant) for action and to all other licensees for information.

The generic letter required that, within 45 days from the date of the generic letter, each addressee provide an assessment of whether or not the licensing basis for each facility is still satisfied with regard to the requirements for system response to a single failure in the Rod Control System (GDC 25 or equivalent). If the assessment (Required Response 1.(a)) indicates that the licensing basis is not satisfied, then the licensee must describe compensatory short-term actions consistent with the guidelines contained in the generic letter, and within 90 days, provide a plan and schedule for long-term resolution (Required Response 1.(b)). Subsequent correspondence between the Westinghouse Owners Group and the NRC resulted in schedular relief for Required Response 1.(a) (NRC Letter to Mr. Roger Newton, dated July 26, 1993).[2] This portion of the required actions will now be included with the 90-day licensee response.

Northeast Nuclear Energy Company (NNECO) hereby submits the attached information in response to the Generic Letter as it applies to Millstone Unit No. 3. As requested by the NRC letter to Mr. Roger Newton, this response

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(1) James G. Partlow letter to All Holders of Operating Licensees or Construction Permits for Westinghouse (W) - Designed Nuclear Power Reactors Except Haddam Neck, "Rod Control System Failure and Withdrawal of Rod Control Cluster Assemblies, 10 CFR 50.54(f) (Generic Letter 93-04)," dated June 21, 1993.

(2) NRC letter to Mr. Roger Newton, Westinghouse Owners Group, "WOG Request for Schedular Relief in Responding to NRC Generic Letter 93-04," dated July 26, 1993.

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summarizes the compensatory actions taken by NNECO in response to the Salem rod control system failure event. Also as requested by the July 26, 1993, letter, it provides a summary of the results of the generic safety analysis program conducted by the Westinghouse Owners Group and its applicability to Millstone Unit No. 3. NNECO considers this action to be complete with respect to the 45-day response to Generic Letter 93-04 (as amended by the July 26, 1993, NRC letter to Mr. Roger Newton).

Please contact us if you have any questions.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

J. F. Opeka
Executive Vice President

cc: T. T. Martin, Region I Administrator
V. L. Rooney, NRC Project Manager, Millstone Unit No. 3
P. D. Swetland, Senior Resident Inspector, Millstone Unit Nos. 1, 2, and 3

Subscribed and sworn to before me

this 4th day of August, 1993

Laura M. Porzanowski
Notary Public

Date Commission Expires: 12/31/97

Docket No. 50-423
B14567

Attachment No. 1

Millstone Nuclear Power Station, Unit No. 3

Response to Generic Letter 93-04
Compensatory Actions

August 1993

Millstone Nuclear Power Station, Unit No. 3

Response to Generic Letter 93-04
Compensatory Actions

The purpose of this discussion is to provide a response to that portion of Generic Letter 93-04 Reporting Requirement 1.(b) which requests that NNECO describe any compensatory short-term actions taken or that will be taken to address any actual, potential, degraded or nonconforming conditions at Millstone Unit No. 3.

NNECO has been working closely with the Westinghouse Owners Group (WOG) to address this issue. NNECO has reviewed the recommendations of the WOG for short-term compensatory measures. The actions taken are consistent with the WOG recommendations; variations are so noted.

Confirm the Functionality of Rod Deviation Alarms

Upon receipt of NSAL-93-007, Westinghouse Nuclear Safety Advisory Letter, "Rod Control System Failure" and Information Notice 93-46, "Potential Problem with Westinghouse Rod Control System and Inadvertent Withdrawal of a Single Rod Control Cluster Assembly," NNECO confirmed the functionality of the rod deviation alarms by reviewing an event which occurred on June 2, 1993 where a rod control card failure had resulted in a rod deviation alarm. This card failure confirmed the operability of the rod deviation alarms.

Heightened Operator Awareness

Heightened operator awareness has been provided by issuing a night order regarding this event. Additionally, the engineering department is in the process of giving a presentation regarding the Salem event to all operating shifts during their respective training weeks. Each crew will have received this presentation by the completion of the present six week training cycle (by the first week of September).

Additional Administrative Controls for Plant Startup and Power Operation

Millstone Unit No. 3 Abnormal Operating Procedure (AOP) 3352, "Malfunction of the Rod Drive System," has been examined and determined to provide sufficient guidance to the operator. If the plant is at power and rod control is in automatic, the operators are trained to immediately verify proper rod movement in response to an audible rod motion demand signal. If rod motion is abnormal, the operator switches to manual control and stops rod motion.

No additional administrative controls are necessary for plant startup. Normal practice is for the operator to manually control rod withdrawal to criticality. There is no reason to believe that operators would permit an unchecked rod withdrawal during startup such that criticality would be reached.

Additional Cautions or Modifications to Surveillance and Preventive Maintenance Procedures

Plant Technical Specification Surveillance Requirement 4.1.3.1.2 requires that each full-length rod not fully inserted in the core shall be determined to be operable by movement of at least ten steps in any one direction at least once per 31 days. As this is a manual action and with the heightened awareness discussed previously, no additional cautions are necessary for this surveillance.

NNECO has planned extensive preventive maintenance of the rod control system for the upcoming refueling outage. This preventive maintenance was previously planned and is not the result of the Salem event. Due to the extent of the planned maintenance, NNECO is in process of writing a new procedure to retest the system prior to declaring it operable. This retest procedure will be sufficiently comprehensive to provide a high level of confidence in the overall functionality of the system.

Short-Term Compensatory Actions Conclusion

NNECO has reviewed this incident very carefully and worked closely with Westinghouse and the WOG to ensure that compensatory actions taken are appropriate. Issues addressed include operator awareness, system performance, procedures, plant startup and power operation and preventive maintenance.

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Attachment 2

Millstone Nuclear Power Station, Unit No. 3

Response to Generic Letter 93-04
Summary of the Westinghouse Generic Safety Analysis Program

August 1993

Summary of the Generic Safety Analysis Program

Introduction

As part of the Westinghouse Owners Group (WOG) initiative, the WOG Analysis Subcommittee is working on a generic approach to demonstrate that for all Westinghouse plants there is no safety significance for an asymmetric RCCA withdrawal. The purpose of the program is to analyze a series of asymmetric rod withdrawal cases from both subcritical and power conditions to demonstrate that DNB does not occur.

The current Westinghouse analysis methodology for the bank withdrawal at power and from subcritical uses point-kinetics and one dimensional kinetics transient models, respectively. These models use conservative constant reactivity feedback assumptions which result in an overly conservative prediction of the core response for these events.

A three-dimensional spatial kinetics/systems transient code (LOFT5/SPNOVA) is being used to show that the localized power peaking is not as severe as current codes predict. The 3-D transient analysis approach uses a representative standard 4-Loop Westinghouse plant with conservative reactivity assumptions. Limiting asymmetric rod withdrawal statepoints (i.e., conditions associated with the limiting time in the transient) are established for the representative plant which can be applied to all Westinghouse plants. Differences in plant designs are addressed by using conservative adjustment factors to make a plant-specific DNB assessment.

Description of Asymmetric Rod Withdrawal

The accidental withdrawal of one or more RCCAs from the core is assumed to occur which results in an increase in the core power level and the reactor coolant temperature and pressure. If the reactivity worth of the withdrawn rods is sufficient, the reactor power and/or temperature may increase to the point that the transient is automatically terminated by a reactor trip on a high nuclear flux or over-temperature delta-T (OTDT) protection signal. If the reactivity rise is small, the rector power will reach a peak value and then decrease due to the negative feedback effect caused by the moderator temperature rise. The accidental withdrawal of a bank or banks of RCCAs in the normal overlap mode is a transient which is specifically considered in plant safety analysis reports. The consequences of a bank withdrawal accident meet Condition II criteria (no DNB). If, however, it is assumed that less than a full group or bank of control rods is withdrawn, and these rods are not symmetrically located around the core, this can cause a "tilt" in the core radial power distribution. The "tilt" could result in a radial power distribution peaking factor which is more severe than is normally considered in the plant safety analysis report, and therefore cause a loss of DNB margin. Due to the imperfect mixing of the fluid exiting the core before it enters the hot legs of the reactor coolant loops, there can be an imbalance in the loop temperatures, and therefore in the measured values of T-avg and delta-T, which

are used in the OTDT protection system for the core. The radial power "tilt" may also affect the ex-core detector signals used for the High Nuclear Flux trip. The axial offset (A.O.) in the region of the core where the rods are withdrawn may become more positive than the remainder of the core, which can result in an additional DNB penalty.

Methods

The LOFT5 computer code is used to calculate the plant transient response to an asymmetric rod withdrawal. The LOFT5 code is a combination of an advanced version of the LOFT4 code (Reference 1), which has been used for many years by Westinghouse in the analysis of the RCS behavior during plant transients and accidents, and the advanced nodal code SPNOVA (Reference 2).

LOFT5 uses a full-core model, consisting of 193 fuel assemblies with one node per assembly radially and 20 axial nodes. Several "hot" rods are specified with different input multipliers on the hot rod powers to simulate the effect of plants with different initial FΔH values. A "hot" rod represents the fuel rod with the highest FΔH in the assembly, and is calculated by SPNOVA within LOFT5. DNBRs are calculated for each hot rod within LOFT5 with a simplified DNB-evaluation model using WRB-1 correlations. The DNBRs resulting from the LOFT5 calculations are used for comparison purposes.

A more detailed DNBR analysis is done at the limiting transient statepoints from LOFT5 using THINC-IV (Reference 3) and the Revised Thermal Design Procedure (RTDP). RTDP applies to all Westinghouse plants, maximizes DNBR margins, is approved by the NRC, and is licensed for a number of Westinghouse plants. The LOFT5-calculated DNBRs are conservatively low when compared to the THINC-IV results.

Assumptions

The initial power levels chosen for the performance of bank and multiple RCCA withdrawal cases are 100%, 60%, 10%, and hot zero power (HZP). These power levels are the same power levels considered in the RCCA Bank Withdrawal at Power and Bank Withdrawal from Subcritical events presented in the plant Safety Analysis Reports. The plant, in accordance with RTDP, is assumed to be operating at nominal conditions for each power level examined. Therefore, uncertainties will not affect the results of the LOFT5 transient analyses. For the at-power cases, all reactor coolant pumps are assumed to be in operation. For the HZP case (subcritical event), only 2/4 reactor coolant pumps are assumed to be in operation. A "poor mixing" assumption was used for the reactor vessel inlet and outlet mixing model.

Results

A review of the results presented in Reference 4 indicates that for the asymmetric rod withdrawal cases analyzed with the LOFT5 code, the DNB design basis is met. As demonstrated by the A-Factor approach (described below) for

addressing various combinations of asymmetric rod withdrawals, the single most limiting case is plant-specific and is a function of rod insertion limits, rod control pattern, and core design. The results of the A-Factor approach also demonstrates that the cases analyzed with the LOFT5 computer code are sufficiently conservative for a wide range of plant configurations for various asymmetric rod withdrawals. In addition, when the design FΔH is taken into account on the representative plant, the DNBR criterion is met for the at-power cases.

At HZP, a worst-case scenario (3-rods withdrawn from three different banks which is not possible) shows a non-limiting DNBR. This result is applicable to all other Westinghouse plants.

Plant Applicability

The 3-D transient analysis approach uses a representative standard 4-loop Westinghouse plant with bounding reactivity assumptions with respect to the core design. This results in conservative asymmetric rod(s) withdrawal statepoints for the various asymmetric rod withdrawals analyzed. The majority of the cases analyzed either did not generate a reactor trip or were terminated by a High Neutron Flux reactor trip. For the OTDT reactor trip, no credit is assumed for the f(ΔI) penalty function. The f(ΔI) penalty function reduces the OTDT setpoint for highly skewed positive or negative axial power shapes. Compared to the plant-specific OTDT setpoints including credit for the f(ΔI) penalty function, the setpoint used in the LOFT5 analyses is conservative, i.e., for those cases that tripped on OTDT, a plant-specific OTDT setpoint with the f(ΔI) penalty function will result in an earlier reactor trip than the LOFT5 setpoint. This ensures that the statepoints generated for those cases that trip on OTDT are conservative for all Westinghouse plants.

With respect to the neutronic analyses, an adjustment factor ("A-Factor") was calculated for a wide range of plant types and rod control configurations. The A-factor is defined as the ratio between the design FΔH and the change in the maximum transient FΔH from the symmetric and asymmetric RCCA withdrawal cases. An appropriate and conservative plant-specific A-Factor was calculated and used to determine the corresponding DNBR penalty or benefit. With respect to the thermal-hydraulic analyses, differences in plant conditions (including power level, RCS temperature, pressure, and flow) are addressed by sensitivities performed using THINC-IV. These sensitivities are used to determine additional DNBR penalties or benefits. Uncertainties in the initial conditions are accounted for in the DNB design limit. Once the differences in plant design were accounted for by the adjustment approach, plant-specific DNBR calculations can be generated for all Westinghouse plants.

Conclusion

Using this approach, the generic analyses and their plant-specific application demonstrate that for Millstone Unit No. 3, DNB does not occur for the worst-case asymmetric rod withdrawal.

References

1. Burnett, T.W.T., et al., "LOFTRAN Code Description," WCAP-7907-A, April 1984.

2. Chao, Y.A., et al., "SPNOVA-A Multi-Dimensional Static and Transient Computer Program for PWR Core Analysis," WCAP-12394, September 1989.

3. Friedland, A.J. and S. Ray, "Improved THINC IV Modeling for PWR Core Design," WCAP-12330-P, August 1989.

4. Huegel, D., et al., "Generic Assessment of Asymmetric Rod Cluster Control Assembly Withdrawal," WCAP-13803, August 1993.