YANKEE ATOMIC ELECTRIC COMPANY

Telephone (508) 779-6711
TWX 710-380-7619

580 Main Street, Bolton, Massachusetts 01740-1398

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United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

References: (a) License No. DPR-3 (Docket No. 50-29)
(b) Letter from USNRC dated September 20, 1989, "Request For Action Related to Resolution of Unresolved Safety Issue A-47, Safety Implication of Control Systems In LWR Nuclear Power Plants Pursuant to 10CFR50.54(f) - Generic Letter 89-19"
(c) NUREG 1217, "Evaluation of Safety Implications of Control Systems in LWR Nuclear Power Plants - Technical Findings Related to USI A-47"
(d) NUREG 1218, "Regulatory Analysis For Resolution of USI A-47"

Subject: Response to Generic Letter 89-19, Safety Issue A-47, "Safety Implication of Control Systems in LWR Nuclear Power Plants"

Dear Sir:

In Reference (b), the USNRC requested that Yankee evaluate the need to modify Yankee Nuclear Power Station's (YNPS) steam generator overfill protection. Attached is Yankee's preliminary assessment. This assessment is based upon the design of the YNPS Feedwater System, steam generator overfill scenarios (including human actions), impact on risk, and other unique factors. The assessment indicates that additional hardware and procedural modifications to further achieve steam generator overfill protection are not warranted.

However, Yankee plans to perform additional analyses to confirm the conclusions of this assessment. The scope and schedule of these confirmatory analyses will be provided to you by July 2, 1990.

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We trust you will find this submittal satisfactory, however, should you desire additional information please contact us.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

S. P. Schultz
Vice President

SPS/mma/WPP44/3

Attachment

cc: USNRC Region I
USNRC Resident Inspector

COMMONWEALTH OF MASSACHUSETTS)
)ss
WORCESTER COUNTY)

Then personally appeared before me, S. P. Schultz, who, being duly sworn, did state that he is Vice President of Yankee Atomic Electric Company, that he is duly authorized to execute and file the foregoing document in the name and on the behalf of Yankee Atomic Electric Company and that the statements therein are true to the best of his knowledge and belief.

Helen D. Sammarco Notary Public
My Commission Expires November 7, 1991

ATTACHMENT

Response to GL 89-19, (Safety Implications of Control Systems...)

SUMMARY

An evaluation in response to Reference (b) indicates that additional hardware and procedural modifications to achieve further steam generator overfill protection for the Yankee Nuclear Power Station (YNPS) are not warranted. The basis for this conclusion is as follows:

(A) A four-part plant-specific evaluation of the need for additional steam generator overfill protection at the YNPS was performed to respond to GL 89-19 and is described in the Discussion section of this attachment.

Specific YNPS features support the following conclusions with reference to the generic assessment:

1. The frequency of an overfill event is less;

2. The potential for core damage given an overfill event is less; and

3. The potential consequences of core damage are less due to plant size and location.

Thus, the potential risk reduction is less. The cost of installation would be about the same as assessed for the generic assessment. Therefore, the generic cost-benefit assessment is inappropriate.

(B) The general bases for GL 89-19 do not provide sufficient evidence of applicability to the YNPS such that plant-specific modifications are appropriate. Specifically, insufficient information is available regarding the net positive and negative impacts of the suggested modifications to warrant commitment to them. For example, the suggested modifications have the potential for increasing the frequency of an unrecovered loss of feedwater, which has never occurred at the YNPS in 30 years of operation.

DISCUSSION

This evaluation of the need for additional steam generator overfill protection at the YNPS addresses four plant-specific factors:

- YNPS Feedwater Control System.
- Steam Generator Overfill Scenarios.
- Unique Factors.
- Impact on Risk at the YNPS.

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These items are described in the following subsections to support the conclusion that additional hardware and/or procedural modifications to achieve further steam generator overfill protection for the YNPS are not warranted.

A. The YNPS Feedwater Control System

The present Steam Generator Water Level Control System was installed in 1984. The state-of-the-art three element control system was purchased and installed in accordance with the Quality Assurance Program, though it is commercial grade. It is supplied from the two independent station vital buses which are in turn backed by an optional feature to supply power from an independent station battery in the event of a loss of a vital bus supply. Two steam generator level controls are supplied from each independent power supply and each generator level control is independent with respect to sensors and control cards. This results in a reliable system with optimal independence between individual level controls and redundancy of power supplies.

The YNPS Control Room has significantly less controls, indications and alarms than the reference plant in GL 89-19. This results in a much simpler control board with less chance for operator confusion.

B. Steam Generator Overfill Scenarios

1. Feedwater Control Induced Events at Low Power Operation (Less Than 15 MWe)

The Feedwater System at the YNPS is normally controlled by the Steam Generator Water Level Control System except during low power operation. During low power operation the Level Control System is manually controlled by an operator who is charged with maintaining at least a minimum flow and maintaining normal level in each steam generator.

At low power an overfill event is readily discernible and sufficient time is present for the operator to take mitigative action. The Narrow Range Steam Generator Level Alarm on the main control board is independent of the Level Control System and would, therefore, alarm at a level of 10 inches above the normal level setpoint. There is also a high level alarm driven by the Steam Generator Wide Range Level channels. The operator then has the ability to take diverse actions to terminate the overfeed condition. He can take manual control of the Feedwater Regulating Valves, trip the feedwater pumps, and/or close the boiler feed header stop, motor operated valves.

2. Feedwater Control Induced Events at Power Operation (Greater Than 15 MWe)

At full power an overfill event is readily discernible and sufficient time is present for the operator to take mitigative action. The Narrow Range Steam Generator Level Alarm on the main

control board is independent of the Level Control System and would, therefore, alarm at a level of 10 inches above the normal level setpoint. There is also a high level alarm driven by the Steam Generator Wide Range Level channels. The operator then has the ability to take diverse actions to terminate the overfeed condition. He can take manual control of the Feedwater Regulating Valves, initiate a manual reactor scram which in turn trips all feedwater pumps upon either of the two scram breakers opening, manually trip the feedwater pumps should they fail to automatically trip, and/or close the boiler feed header stop, motor operated valves.

3. Feedwater Control Response to Other Initiating Events

Upon a reactor scram from power levels greater than 15 MWe, the boiler feed pumps receive a trip signal from either scram breaker. Operator actions for plant trip from power provide further backup for this automatic action. The operator verifies reactor scram and turbine trip, verifies feedwater pumps trip, closes all boiler feed header stop, motor-operated valves and closes the main feedwater regulating valves on any plant trip from power levels greater than 15 MWe. Thus, since these actions are proceduralized, frequently trained and reinforced by simulator exercises, the operator's actions can be relied upon to occur with a high degree of confidence.

Post-trip feedwater is restored on manual bypass flow following the trip. It cannot be restarted before 2.5 minutes due to a safety interlock.

Plant Emergency Operating Procedures provide direct instructions to the operators to take specific steps to control feedwater flow and steam generator level.

Finally, the generic reference case assumes that an overfill condition ultimately results in a steam line rupture and challenges the steam generator tube integrity resulting in a LOCA outside containment. The YNPS provides the following features to mitigate this scenario:

1. The steam lines are equipped with actuators to prevent blowdown of all four steam generators. Isolation is also provided by a nonreturn (check) valve which requires no active device to prevent the blowdown of more than the affected steam generator on an upstream break and

2. If a Steam Generator Tube Rupture (SGTR) were to occur, the four main coolant loops are equipped with loop isolation valves capable of terminating the LOCA.

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C. Unique Factors

The plant is located in a river valley on a 2,000 acre site in the rural northwestern corner of Massachusetts. The area is sparsely populated with 60 people within a one mile radius of the plant, 1,600 within a five mile radius and 24,000 within a ten mile radius. The low population zone of the plant extends two miles upstream and six miles downstream from the plant and has an estimated population of 260 persons. The population density within five miles is 20 persons per square mile. The population numbers have remained stable since the plant was built and are expected to remain stable in the future.

The YNPS was licensed for operation on July 9, 1960, and has recently completed 29 years of safe, reliable operation with a lifetime capacity factor exceeding 70%. The plant set its all-time record of over 330 days of continuous operation during its 25th year of operation, which attests to its continuing fine performance. Past evaluations by NRC have identified the YNPS as a low frequency "outlier" with regard to feedwater transients. YNPS has never challenged the Emergency Feedwater System.

D. Impact on Risk at the YNPS

In 1981 Yankee initiated a probabilistic study of risks associated with the operation of the plant. The Yankee Nuclear Power Station Probabilistic Safety Study (PSS) was conducted to provide additional insights into plant design and operation as well as to incorporate the latest analytical tools into the decision making process. A spectrum of internal events ranging from plant trip to large break LOCA was examined.

The results of the PSS demonstrate that operation of Yankee Nuclear Power Station poses a very small risk to public health and safety both according to the context of NRC proposed safety goals, and comparisons with other probabilistic safety studies performed for other nuclear power plants. Using a model based on certain conservative assumptions (e.g., Appendix K based success criteria), the calculated mean core melt frequency for YNPS is less than 2×10^{-5} per year and the corresponding individual fatality risk is about a factor of 2,600 lower than NRC safety goals.

The low core melt frequency results from the conservative and diverse design of the Nuclear Steam Supply System and associated support systems. In general, the YNPS has more systems available, and they are simpler in design, than contemporary plants. Additionally, the frequency of off-normal events has been shown to be small during its 30 years of operation.

In the YNPS PSS, Yankee explicitly investigated the potential for and consequences of excessive feedwater, as an initiating event and following an initiating event. Such events were not found to be important. The more recent investigations support this earlier conclusion.

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CONCLUSION

Thus, the GL 89-19 recommendations for additional steam generator overfill protection are inappropriate when applied to the YNPS. Additional investigations will be performed to confirm this conclusion. The scope and schedule of these analyses will be provided per the cover letter.