February 24, 1995

Mr. E. Thomas Boulette, Ph.D
Senior Vice President - Nuclear
Boston Edison Company
Pilgrim Nuclear Power Station
RFD #1 Rocky Hill Road
Plymouth, MA 02360

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION - REVIEW OF PROPOSED REPAIR OF PILGRIM CORE SHROUD (TAC NO. M91305)

Dear Mr. Boulette:

Enclosed is a list of questions related to the subject repair submitted by the Boston Edison Company in letter dated January 16, 1995.

This requirement affects fewer than 10 respondents and therefore is not subject to Office and Budget review under P.L. 96-511.

Your written response to these questions is requested as soon as possible in order to facilitate our review. Please do not hesitate to contact me if you have any questions on this matter.

Sincerely,

Original signed by:
Ronald B. Eaton, Senior Project Manager
Project Directorate I-3
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket No. 50-293

Enclosure: Request for Additional Information

cc w/encl: See next page

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REQUEST FOR ADDITIONAL INFORMATION REGARDING THE PROPOSED REPAIR OF THE PILGRIM CORE SHROUD

The following questions pertain to the licensee's submittal dated January 16, 1995, which provided the design report for the repair of the Pilgrim core shroud:

1. If the Pilgrim plant is to be uprated in power at a future time, how will this affect the design margin for the core shroud repair?

2. Since the stabilizer assemblies are installed prior to any actual weld failures, the failure of the H2 and H3 welds and the H7 and H8 welds will result in some reduction of the tie rod preload. Provide an evaluation describing how the failure of welds H2, H3, and H7, and H8 have been accounted for in determining the necessary tie rod tensioning to prevent vertical separation of the most adverse combination of failed welds during normal operation.

3. The recirculation line break (RLB) loading greatly fluctuates with respect to time, which will result in significant dynamic amplification of the loads onto the shroud. In the analysis of the RLB loads on the core shroud, have the loads been dynamically applied to the shroud structure? If not, provide an evaluation of the repaired core shroud with dynamically applied RLB loads.

4. GE-NE-B1100617-03, Rev. 1, states that the main steam line break (MSLB) alone is the only event which causes the core shroud to loose compressive load since the lateral safe-shutdown earthquake (SSE) loading in combination with the loss-of-coolant accident (LOCA) causes the failed shroud sections to remain in contact. However, the lateral SSE loading will cause tipping which will result in separations at least on one side of the shroud. Provide the maximum transient vertical separations of the failed shroud welds for all plant transient and accident events or combinations thereof.

5. For the limiting vertical separations at the various weld locations, do the stabilizers restrain all of the loads, or do the control rod drive guide tubes, core spray piping, or any other reactor internal structures restrain some of the transient loads? Provide an evaluation of these safety components to assure their structural integrity and to assure they remain capable of performing their safety functions. Also, following the separation of the shroud during emergency and faulted events, the upper portion above the various failed welds will impact the lower portion of the shroud. Especially for the SSE where the core shroud tips, the seismic loading is applied and is removed very quickly such that the tie rod (and gravity) forces will snap the core shroud back into position. Provide an evaluation of the kinetic energy of the moving mass and its effect on the structural integrity of the shroud, fuel, control rods, reactor vessel and any other safety component?

6. GE-NE-B1100617-03, Rev 1. states that there are no permanent radial deflections resulting from any of the required design conditions. However, the assumed analysis models of either hinges or rollers at the crack interfaces would not appear to conservatively model possible permanent radial displacements since any friction between sliding sections of the shroud would prevent the radial springs from entirely pushing the sections back into place. Provide an evaluation of the resulting radial deflections with frictional sliding at the crack interfaces.

7. It is stated that the component stress evaluations are determined from the dynamic analysis of the horizontal seismic loads in combination with the vertical seismic loads. How were the horizontal and vertical loads combined (i.e. by absolute summation or by another method), and how were they combined according to the original plant design basis? Similarly, how were the SSE and LOCA dynamic loads combined for the two faulted service conditions, and how were they combined in the original design of the core shroud?

8. The analysis of the two faulted load combinations of SSE + LOCA involves a linear-elastic analysis method. However, the core shroud and repair stabilizer structure is not one having linear stiffness characteristics. There are gaps in the failed shroud structure which affect not only the mass continuity, but the stiffness of the shroud as well. When the gaps are closed, the shroud is a continuous structure in compression, but when the gaps open, there is no stiffness of the shroud above the gaps. Provide an evaluation of the effects of the structural gaps and any other structural nonlinearities that can affect the analysis results.

9. Describe how uncertainties are accounted for in structural modeling for the time history analyses, similar to peak broadening for a response spectrum analysis.

10. GE-NE-B1100617-03, Rev. 1, discussed the increased carryunder effect on jet pump cavitation margin. Provide the analysis that demonstrates that the jet pump cavitation margin remains adequate and will not cause any unreviewed safety questions.

11. At increased carryunder from the induced shroud head leakage, the combined effective carryunder slightly exceeds the design criteria at 75% rated core flow. While operating at 75% rated core flow, what effect does exceeding the carryunder design criteria have on jet pump integrity, emergency core cooling system (ECCS) performance, and net positive suction head (NPSH) for the recirculation pumps?

12. Provide the ECCS performance analysis with respect to the increased carryunder during the limiting LOCA event to show that 10 CFR 50.46 is not exceeded.

13. Provide the analysis of the downcomer flow characteristics with the four stabilizers installed. Specifically, address the available flow area in the annulus, the associated pressure drop, and the impact on reactor coolant level, recirculation flow, and ECCS performance.

14. Boiling Water Reactor Vessel and Internals Project (BWRVIP) has issued the following documents to provide guidelines for visual examination (VT) and ultrasonic examination (UT) of core shrouds: (a) BWRVIP, "Standards For Visual Inspection of Core Shrouds," September 8; 1994, and (b) BWRVIP Core Shroud nondestructive examination (NDE) Uncertainty & Procedure Standard, November 21, 1994. The guidelines in these documents should be followed in the examination of the core shroud and repair assemblies. The subject BWRVIP documents should also be referenced in the appropriate examination specifications.

    The staff notes that in Section 4.0 of Repair Examination in the field disposition instruction (FDI) (0228-78003, Revision c) the required resolution for the television camera is defined as capable of resolving a 0.001 inch wire on a neutral gray background. This requirement should be changed to be consistent with the required resolution of a 0.0005 inch wire as recommended in the above referenced BWRVIP document for visual examination of core shrouds.

15. Please discuss the mitigation methods that you plan to apply to the machined threads such as re-solution annealing to minimize the cold work effect. Please also describe how the methods were qualified and the details of controls for application.

16. In the safety evaluation for installation of stabilizers (GE-NE-B1100617-03, Rev. 1), General Electric stated that a minimum of 0.030 inches will be removed from Alloy X-750 materials after the last exposure to acid pickling or high temperature annealing as a control of intergranular attack (IGA). Will this process or any other process be applied to components made of type XM-19 and type 316 stainless steel after pickling or annealing to ensure there is no pitting or IGA? Please provide the test data to support that the removal of 0.030 inches surface material would effectively eliminate the pitting or IGA effect resulting from the pickling or high temperature annealing.

17. Please identify all the threaded areas and locations of crevices and stress concentration in each component of the core shroud repair assemblies. In the planning of inservice inspection, those areas should be emphasized for inspection because these areas are most susceptible to stress corrosion cracking. Please provide these information in tables and supplement it with sketches.

18. Please provide details of your controls in the practices of machining, grinding and threading to minimize the effect of cold work, such as amount of materials to be removed in each pass, application of coolant and sharpness of the tool.

19. In the design requirements for reactor shroud repair (Specification No. M1B-1, Revision E0), GE stated that all parts have been designed to be removable. This design feature should be taken advantage of when planning inservice inspection of the core shroud repair components. The staff realize that the repair assemblies may be inspected by a combination of visual and ultrasonic examinations. However, the staff has some concerns regarding the reliability of such inspection to identify the potential

degradation in the threaded joints and areas of crevices and stress concentration, which have limited access for inspection. Please provide a discussion and/or propose an alternative inspection such as disassembling the threaded joints for inspection to ensure that the areas mentioned above in the repair assemblies will be adequately inspected for early detection of potential degradation.

20. Please provide your basis for inspecting only 4 inches of each vertical weld intersecting at H-4 weld (ID and OD).

21. Please provide details of your planned inservice inspection (location, extent, frequency, methodology and justification) of the installed core shroud repair components. Your planned inspection should consider the staff recommendation in item 19.

22. Please identify the lubricants that would be used on the machined threads during installation. What are the controls of the content of chlorides, sulfides, halogens and other elements that are known to promote stress corrosion cracking in stainless steel and high nickel alloy?

23. Please describe the methods and its accuracies in monitoring the magnitude of the preload in the springs and tie rods to ensure there is no substantial relaxation of the preload. Please also discuss the safety consequences if the preload is completely relaxed.

24. Recently, IGSCC was observed in the welds (heat affected zones) of the top guide and core support plate in an overseas boiling-water reactor (BWR). Therefore, the staff recommends that the welds in the top guide and core support plate at Pilgrim should be inspected during the upcoming refueling outage to ensure there is no unacceptable degradation.

25. Please discuss the reasons that GE selects XM-19 material for the tie rods instead of austenitic 304 or 316 stainless steel (low carbon content). The 304 or 316 stainless steel has extensive service experience in the BWR environment. It should be noted that the acceptable yield strength of XM-19 material is limited to 90 ksi. Since there is limited service experience of XM-19 material in the BWR environment, the staff recommends that an accelerated stress corrosion testing of a mock-up simulating the XM-19 tie rod thread joint in a BWR environment should be performed to ensure there is no development of unexpected degradation.

26. If the credit for the fillet or any circumferential welds in the core shroud is taken in the design of the proposed repair to maintain the required preload, please discuss in detail and provide the justification regarding the measures you plan to take such as inspection to ensure the welds are, and remain, in the condition assumed in the analyses. Please also discuss the feasibility of measuring the preload during plant operation.

If complete information for items 17, 19, 21 and 23 cannot be provided at this time, identify the date when such information will be provided.