CENTERIOR ENERGY

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Subject: High Pressure Injection/Makeup Nozzle and Thermal Sleeve Program
Davis-Besse Nuclear Power Station Unit 1

Gentlemen:

By letter dated May 3, 1990 (Serial Number 1802), Toledo Edison summarized the actions taken during Cycle 6 and the sixth refueling outage (6RFO) resulting from the discovery of the failed HPI/Makeup nozzle thermal sleeve during the fifth refueling outage (5RFO) at the Davis-Besse Nuclear Power Station (DBNPS) Unit 1. On May 10, 1990, representatives of Toledo Edison met with the NRC staff to discuss the actions taken. Toledo Edison's letter to the NRC dated May 25, 1990 (Serial Number 1808) documents this meeting.

The major actions taken through the end of the 6RFO were directed toward the assessment and preservation of the structural integrity of the nozzle which experienced the thermal sleeve failure. At the May 10, 1990 meeting, the NRC staff accepted the conclusion that an intact thermal sleeve effectively protects the HPI/Makeup nozzle from the effects of thermal cycling fatigue due to cold makeup or HPI water and hot reactor coolant being mixed in the vicinity of the nozzle. Consequently, assurance of long term thermal sleeve integrity is a matter of continuing importance. The improvements made in makeup flow control described in Toledo Edison's letters to the NRC dated September 19, 1988 (Serial Number 1580), May 3, 1990 (Serial Number 1802) and May 25, 1990 (Serial Number 1808) provide assurance that thermal sleeve life in makeup service is greater than the four operating cycles experienced by the original thermal sleeve. By letter dated May 3, 1990 (Serial Number 1802), Toledo Edison stated its intention to continue to investigate mechanisms which affect thermal sleeve life, and evaluate alternatives which might be pursued to ensure long-term reliability. The purpose of this letter is to provide details of Toledo Edison's plans and schedule to address thermal sleeve reliability.

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Toledo Edison's plans to address thermal sleeve reliability focus on the conservative assessment of thermal sleeve life. A conservative estimate of thermal sleeve life is essential to development of an effective strategy to manage thermal sleeve reliability. A fracture mechanics approach will be used to predict thermal sleeve life for various makeup flow conditions. Flaw initiation and growth studies will be performed for the thermal sleeve to predict thermal sleeve life for various makeup flow conditions. Fluid temperature distributions for bounding states of each of the defined flow conditions will be developed. The fluid temperature distributions will be used to perform thermal stress analysis of the thermal sleeve. The stress analysis will subsequently be used in fracture mechanics evaluations of the thermal sleeve with respect to both flaw initiation and flaw growth. From the fracture mechanics analysis, the life of the thermal sleeve will be determined for various makeup flow conditions. Multiple makeup flow conditions will be investigated to provide insight into the optimization of makeup flow control from the standpoint of thermal sleeve life. This prediction of thermal sleeve life in combination with a review of operating experience will provide a conservative estimate of expected thermal sleeve life.

The strategy developed to assure thermal sleeve reliability during plant operation will depend on this conservative estimate of thermal sleeve life. Potential strategies which may be considered include periodic thermal sleeve inspection/replacement at a frequency dependent on the estimated life. It is also conceivable that the estimated thermal sleeve life could exceed the licensed life of the plant under current or future makeup flow scenarios, obviating the need for periodic inspection/replacement.

In addition to the estimation of thermal sleeve life, the impact of premature thermal sleeve failure on HPI/Makeup nozzle structural integrity will be assessed. This assessment, consistent with the experience following the failure of the makeup thermal sleeve at Davis-Besse reported in 1988, is expected to demonstrate that plant operation for the remainder of a fuel cycle would be acceptable in the event of a premature thermal sleeve failure, and that on-line monitoring for thermal sleeve integrity would be unnecessary. A fracture mechanics approach will be used to assess the impact of premature thermal sleeve failure on the HPI/Makeup nozzle structural integrity assuming occurrence of the failure at the beginning of a fuel cycle. Existing finite element models of the HPI/Makeup nozzle will be used to analyze stresses in nozzle induced by makeup flow cycling for various makeup flow scenarios. The expected period of time to flaw initiation and rate of propagation will be determined. This evaluation will establish the margin of safety which exists for continued plant operation with a failed thermal sleeve for the remainder of a fuel cycle without incurring significant nozzle damage.

Although the above evaluations will likely demonstrate that on-line monitoring for thermal sleeve integrity is unnecessary; as a contingency, Toledo Edison is conducting preliminary investigations of the feasibility of thermal and acoustic monitoring concepts. The feasibility of thermal monitoring depends on the ability to discriminate between nozzle temperature distributions with and without an intact thermal sleeve. Three-dimensional thermal conduction analyses will be performed for various makeup flow conditions, with and without an intact thermal sleeve. Temperature contours through the thickness and around the circumference of the nozzle will be determined for these cases. Based on sensitivity studies of the results of these analyses, the feasibility of strategically locating thermocouples to accurately discriminate between cases with intact and failed thermal sleeves will be assessed. Acoustic monitoring involves discriminating between acoustic signatures an intact sleeve and a failed thermal sleeve. A literature review of acoustic emission technology and a survey of acoustic emissions experts will be carried out to ascertain whether this concept merits further consideration.

Toledo Edison plans to complete and inform the NRC of the results of the above described evaluations by August 1, 1991.

During the May 10, 1990 meeting with the NRC staff, Toledo Edison was requested to address the need for future inspection of the currently used HPI/Makeup nozzle (A2) in conjunction with activities related to thermal sleeve reliability. Toledo Edison believes that consideration of further inspection of this nozzle is not warranted pending completion of the above evaluations. This conclusion is based on the fact that this nozzle and thermal sleeve had not been used for makeup service prior to Cycle 7, the baseline enhanced UT of nozzle A2 indicated no flaws of concern, the thermal sleeve life is reasonably assured to be greater than four operating cycles, and that an intact thermal sleeve effectively protects the nozzle from the thermal fatigue driving force of the cold makeup water/hot reactor coolant interface.

Should you have any questions regarding Toledo Edison's plans to address thermal sleeve reliability, please contact Mr. R. W. Schrauder, Manager - Nuclear Licensing, at (419) 249-2366.

Very truly yours,

PWS/mmb

cc: P. M. Byron, DB-1 NRC Senior Resident Inspector
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