UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

50-220

June 9, 1997

Mr. David A. Lochbaum
Union of Concerned Scientists
1616 P Street, NW., Suite 310
Washington, DC 20036-1495

Dear Mr. Lochbaum:

I am responding to your letters of April 9 and 17, 1997, in which you express concerns about cracking in the heat-affected zones of Nine Mile Point Nuclear Station Unit 1 (NMP1) core shroud welds and anomalies for the shroud tie rods.

In your April 17 letter, you note, in particular, that the Technical Specification (TS) limit for reactor coolant conductivity exceeds the value used in the analysis for crack growth rate and operating interval, and you believe the TS should be changed or the analysis revised before restart. Specifically, TS 3.2.3 limits reactor coolant conductivity to less than 2 μmho/cm with steaming rates less than 100,000 pounds per hour and to less than 5 μmho/cm with steaming rates greater than 100,000 pounds per hour. Because this figure exceeds the conductivity value of about 0.3 μmho/cm associated with the bounding crack growth rate (5×10^{-5} inch per hour) assumed in the analysis supporting a minimum operating time (10,600 hours) until the next inspection, you believe TS 3.2.3 should be consistent with the lower conductivity value (or that the analysis should use the conductivity limit in the existing TS).

The conductivity value of 0.3 μmho/cm assumed in the core shroud analysis[1] is an average operating value and is administratively controlled by Niagara Mohawk Power Corporation (NMPC) for service life considerations. It is based upon generic guidelines issued by the Electric Power Research Institute (EPRI) in technical report TR-103515, "BWR Water Chemistry Guidelines--1996 Revision." NMPC has incorporated the EPRI guidelines--both values and action levels--into its Nuclear Division Directive on Chemistry and into chemistry department surveillance procedures. Thus, NMPC's administrative controls ensure that the analyzed assumption for normal operating reactor conductivity will be maintained. The ability to meet these guidelines has been demonstrated by past performance at NMP1 in that the average normal operating conductivity level has been below 0.1 μmho/cm over the last three operating cycles and below 0.3 μmho/cm over the last seven cycles.

NRC agrees with you that chemistry is an important factor in controlling shroud weld cracking caused by intergranular stress corrosion cracking. Therefore, NRC approval under 10 CFR 50.55a(a)(3)(i) is contingent upon NMPC (1) maintaining reactor coolant chemistry within the guidelines set forth in

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[1] The use of 0.3 μmho/cm with the bounding crack growth rate of 5×10^{-5} in/hr is conservative as the laboratory tests from which the underlying data were derived had conductivity values ranging from 0.3 to 0.7 μmho/cm in 288 °C water containing 200 ppb oxygen, and from 0.5 to 1.5 μmho/cm in 288 °C water containing 6000 ppb oxygen. The conductivity in the tests was induced by adding sulfate because it (along with chloride) is among the more aggressive anions relative to crack acceleration in stainless steel in high- temperature water.

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Electric Power Research Institute technical report TR-103515, "BWR Water Chemistry Guidelines-1996 Revision," in accordance with its commitment by letter dated April 30, 1997, and (2) submitting, within 60 days, an application for a license amendment that addresses this matter in accordance with its commitment by letter dated May 7, 1997. Failure to satisfy either of these conditions will render NRC's approval null and void.

In your April 17 letter, you also identified three questions from the NRC's meeting with the public in Oswego, New York on April 14, 1997, that you believe need to be answered, and to which you requested a formal response. As indicated at the meeting, questions received from the public regarding the inspection and evaluation of the core shroud and the tie rods have been incorporated into the NRC staff's review and, if appropriate, are addressed in the enclosed safety evaluation report (SER). You will find the answers to your three questions in the SER and letters from NMPC as identified below:

1a. Whether crack growth rate after progressing through-wall remains the same as prior to becoming through-wall:

By the enclosed letter dated April 25, 1997, NMPC responded that "crack growth rate in the length direction is still bounded by the 5×10^{-5} in/hr used in the analysis. Therefore, there is no fundamental difference in crack growth rate when the crack becomes through wall."

The NRC staff agrees with the NMPC response. Further, since intergranular stress-corrosion cracking is fundamentally driven by residual stresses and cracking tends to relieve residual stresses, the crack growth rate is conservative. For details see SER Sections 4.2.1 to 4.2.4.

1b. Whether through-wall cracking creates the potential for vibrations that can increase the propagation rate:

In the April 25, 1997, letter, NMPC replied that:

> Postulated vibration would result from through wall bypass leakage, however, the predicted leakage rate from a potential through wall crack of this length is expected to be less than 10 gpm, less than 0.005% of the core mass flow.
>
> This has negligible impact on the potential for vibration. Therefore, the possibility of vibration resulting from a throughwall crack will have no impact on the crack propagation rate.

The NRC staff agrees with NMPC because a core flow of 10 gpm or less will not have the energy content to produce core shroud vibrations to any appreciable degree and have any discernable impact on the crack propagation rate. Further, the cracked and uncracked shroud were evaluated for flow induced vibration from the coolant in the reactor, and the results demonstrated that the shroud vibrations are insignificant.

2. Whether crack inspections were performed, and whether any cracks exist, beyond the weld heat-affected zone:

See NMPC's letter dated April 25, 1997 (enclosed). Also, in the enclosed letter of April 26, 1997, NMPC states that it has developed a 10 CFR 50.59 safety evaluation for the restart of NMP1 with the as-found condition of the core shroud vertical welds, including cracks found within and adjacent to the weld heat-affected zones and has concluded in this evaluation that "safe operation of the unit is assured and no unreviewed safety questions exist."

As part of its inspection activity, the NRC staff has reviewed the licensee's 10 CFR 50.59 evaluation. The NRC staff discusses inspection coverage and cracks adjacent to the heat affected zone in SER Section 4.1. The NRC staff finds that the stress distribution in the shroud will limit further growth of cracks adjacent to the heat affected zone. Therefore, the NRC staff agrees that these cracks do not give rise to an unreviewed safety question.

3. Whether free-standing cylinders is a conservative assumption for shroud bow effects (since two intact weld segments 180 degrees apart might "pin" movement and increase stress in vertical welds located in the 90 degree plane):

In the April 25, 1997, letter, NMPC replies:

> Taking credit for some integrity of the H4 and H5 welds, it can be shown that through wall cracks in excess of the length of the V9/V10 welds can be tolerated. It is conservative to assume no credit for the circumferential welds since the allowable vertical crack length would then be smaller.
>
> During normal operating conditions, the shroud, with the tie rod repair in place, is under a general state of axial compressive stress. As such, even with complete severance of the H4 and H5 welds, shroud integrity will still be maintained as the character of the flawed welds will not allow differential radial displacement.
>
> Finally, since there is a net compressive force during normal operation, the bow of the type described in the question cannot occur.

The NRC staff has reviewed the calculated stress pattern in the core shroud shell based upon a finite element analytical model. The maximum tensile stresses across V9 and V10 have been determined to be negligibly small and not likely to cause bow in the shroud. In addition, the presence of lateral supports on the tie rods would limit lateral deformations to acceptable levels even under postulated accident conditions. The NRC staff, therefore, concurs with NMPC's assessment.

Similarly, by letter dated April 9, 1997, you requested the NRC to respond to several concerns. The responses to your concerns are contained in the following sections of the SER or letters from NMPC:

1a. Evidence for intergranular stress-corrosion cracking and the age of cracking as needed to determine the crack propagation rate:

See SER Sections 4.1 and 4.2.1.

1b. Acceptable limits for vertical weld cracking:

See SER Sections 4.2.2, 4.2.3, and 4.2.4.

2a, 2c. Status of NMPC's final verification and quality assurance (QA) approvals of core shroud inspection data:

See NMPC's enclosed letters dated April 26 and 27, 1997, wherein NMPC states that final verifications and quality assurance (QA) reviews are complete and revalidated analyses continue to support 10,600 operating hours, although certain values in the analyses had changed.

2b. Status of NMPC's QA review for tie rods:

See NMPC's letter dated April 26, 1997, wherein NMPC reports that inspection data from the as-left condition of the tie rods have been reviewed and approved by QA, design requirements and conditions have been verified, and acceptance criteria have been established.

3a. Whether NMPC has performed a 10 CFR 50.59 evaluation for continued operation with vertical weld cracking:

See NRC staff's response above to question 2 of your April 17, 1997, letter.

3b. Whether NMPC submitted the 10 CFR 50.59 evaluation to the NRC:

The 10 CFR 50.59 evaluation performed by NMPC has not been, and is not required to be, submitted to NRC for review or approval.

NMPC has provided as Enclosure 4 to its letter dated April 8, 1997, "10 CFR 50.59 Safety Evaluation Summary--Modification To The Core Shroud Repair Stabilizer Assemblies," and technical analyses showing that the minimum intact vertical weld segment required by the tie rod assemblies will not be exceeded for the proposed operating cycle of 10,600 hours. As part of its inspection activity, the NRC staff has reviewed the licensee's 10 CFR 50.59 evaluation and associated technical analyses and finds it acceptable.

3c. How the nonconforming and degraded condition of the shroud was resolved:

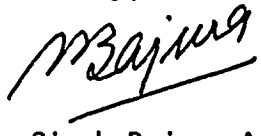
NMPC has analyzed the shroud vertical welds in accordance with Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code and found them to be acceptable. The NRC staff has performed an independent analysis, in addition to reviewing the analyses presented by NMPC, and has concluded that the vertical welds will maintain the required ASME Code margins for the 10,600-hour operating period. NMPC has also concluded that operation as proposed with the core shroud does not give rise to an unreviewed safety question.

4. Whether the extent of cracking in the outside diameter vertical welds at NMP1 is consistent with the experience at other boiling-water reactors (BWRs):

The NRC staff is aware of vertical weld cracking in the outside shroud surface for one other BWR. The extent of vertical weld cracking at NMP1 exceeds that observed at this other BWR. Reinspection guidelines established by the BWR Vessel Internals Project are being modified to ensure that other nuclear power plants consider this experience in their reinspections.

I appreciate your interest in this matter and trust you will find this letter responsive to your concerns.

Sincerely,



S. Singh Bajwa, Acting Director
Project Directorate I-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosures:
1. NRC letter dated May 8, 1997, and SER
2. NMPC letter dated April 25, 1997
3. NMPC letter dated April 26, 1997
4. NMPC letter dated April 27, 1997

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